3.3 Test 3 11-12 September 1979, Fellows Release (0700-1200 PDT)

3.3.1 Meteorology

General

The synoptic meteorology during the test period was characterized by a high pressure ridge at the 500 mb level along the west coast (Figure 3.3.1). Temperatures aloft over Vandenberg and Oakland, as indicated by the trend at 850 mb on Figure 2.2.1 were well above normal and near the highest measured during the September intensive period. At the surface an inverted pressure trough was located with its axis along the coast; farther west than typically. As a consequence, the onshore pressure gradients in central California were weaker than usual. Skies in the San Joaquin Valley were clear during the test. Visibilities throughout the valley generallly ranged between 10 and 15 miles. Surface temperatures were above the average for September. Maximum reported temperatures at Fresno and Bakersfield were 102°F and 104°F, respectively; or about 10° above normal.

Transport Winds

As can be seen from the surface winds at Fellows, which are listed in Table 3.3.1, the flow during the tracer release was typically from the east and directed into the adjacent mountains at speeds on the order of 1-2 m/s. The time cross section of the pibal winds measured at Taft (Figure 3.3.2) supports the general westerly transport at low levels during the release and during the afternoon of the 11th. A short-lived shift to westerly winds accompanied by an increase in wind speed was observed at 2100 PDT but by the next observation the winds had shifted back again to flow from the easterly quadrants. Overall the winds in the Taft-Fellows region were extremely light and what little transport existed was directed westward, out of the valley.

On a regional basis, the flow during the tracer release is shown by the streamlines in Figure 3.3.3. Although a generally cyclonic flow pattern was occurring in a major portion of the valley, the flow in the southwest region remained unaffected. In fact, only slight air movement was observed throughout the southern San Joaquin Valley. Regional flows remained light

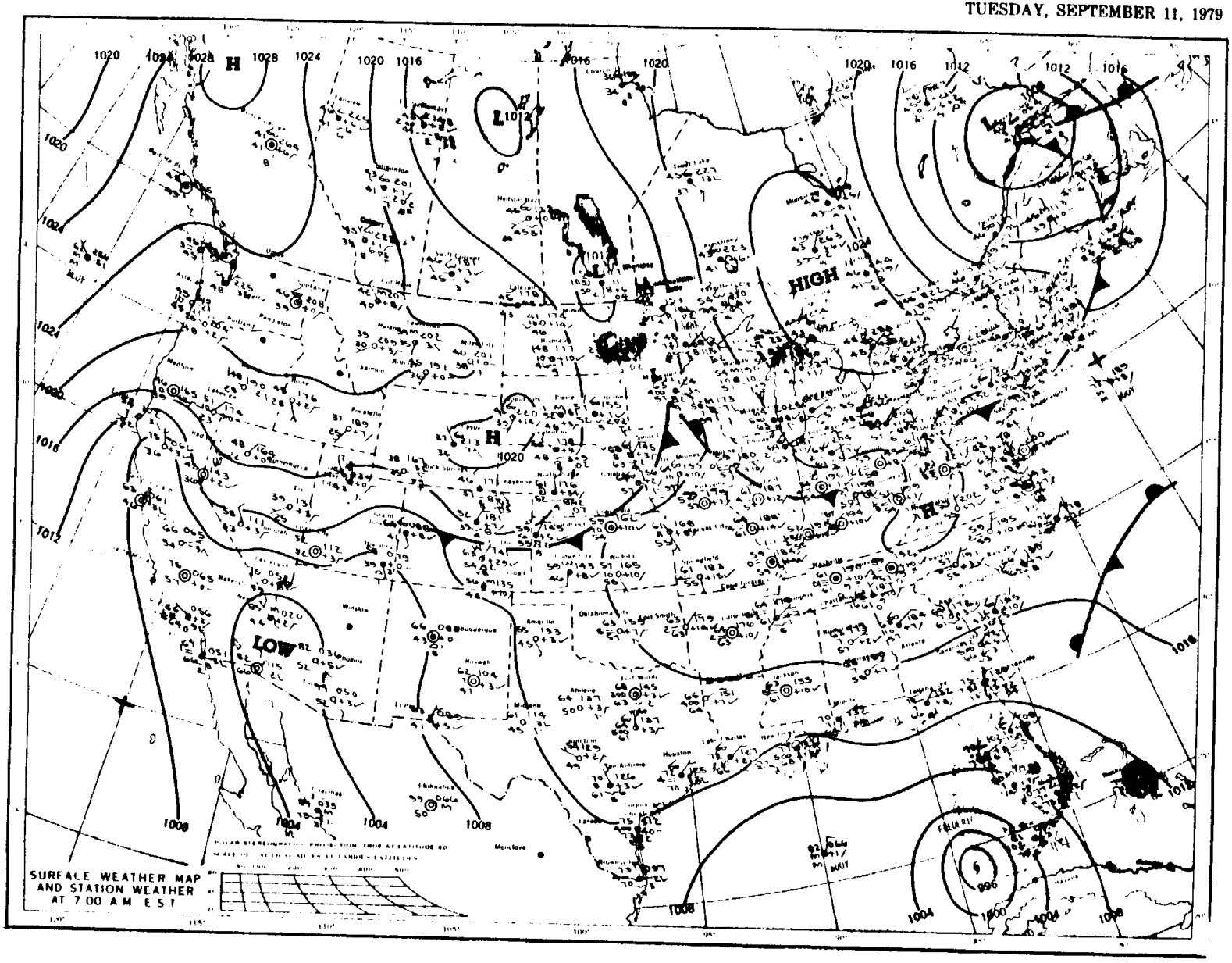


Figure 3.3.1 Surface Weather Chart - 11 September 1979 (05 PDT)

Table 3.3.1

SURFACE WINDS AT FELLOWS
11 SEPTEMBER 1979

Time (PDT)	Wind Direction/Speed (m/s)
0700	115/2.0
0800	045/1.1
0900	050/2.5
1000	045/2.2
1100	090/2.2
1200	150/1.8

and variable during the remainder of the morning and during the early afternoon. By 1500 PDT a valley-wide northwest flow began to develop which continued into the evening. The streamlines depicted in Figure 3.3.4 constructed from the 1700 PDT observations, show the characteristic flow during this period.

Mixing Heights

Mixing heights on the 11th, as determined from the aircraft data (Table 3.3.2) generally were about 600-700 m in the central and southern portions of the valley on September 11. Mixing appeared to extend through a much deeper layer at Taft in the southwest corner of the valley. Mixing occurred within a low layer in the valley early on the following morning, increasing significantly as the morning progressed.

3.3.2 Air Quality

Regional Pollutant Levels

Maximum hourly average ozone concentrations for 11 September are shown on Figure 3.3.5. Numerous violations of the California air quality standard occurred within the valley, mainly near source regions. Maximum ozone concentrations (.16 ppm) were experienced in the urban Fresno area.

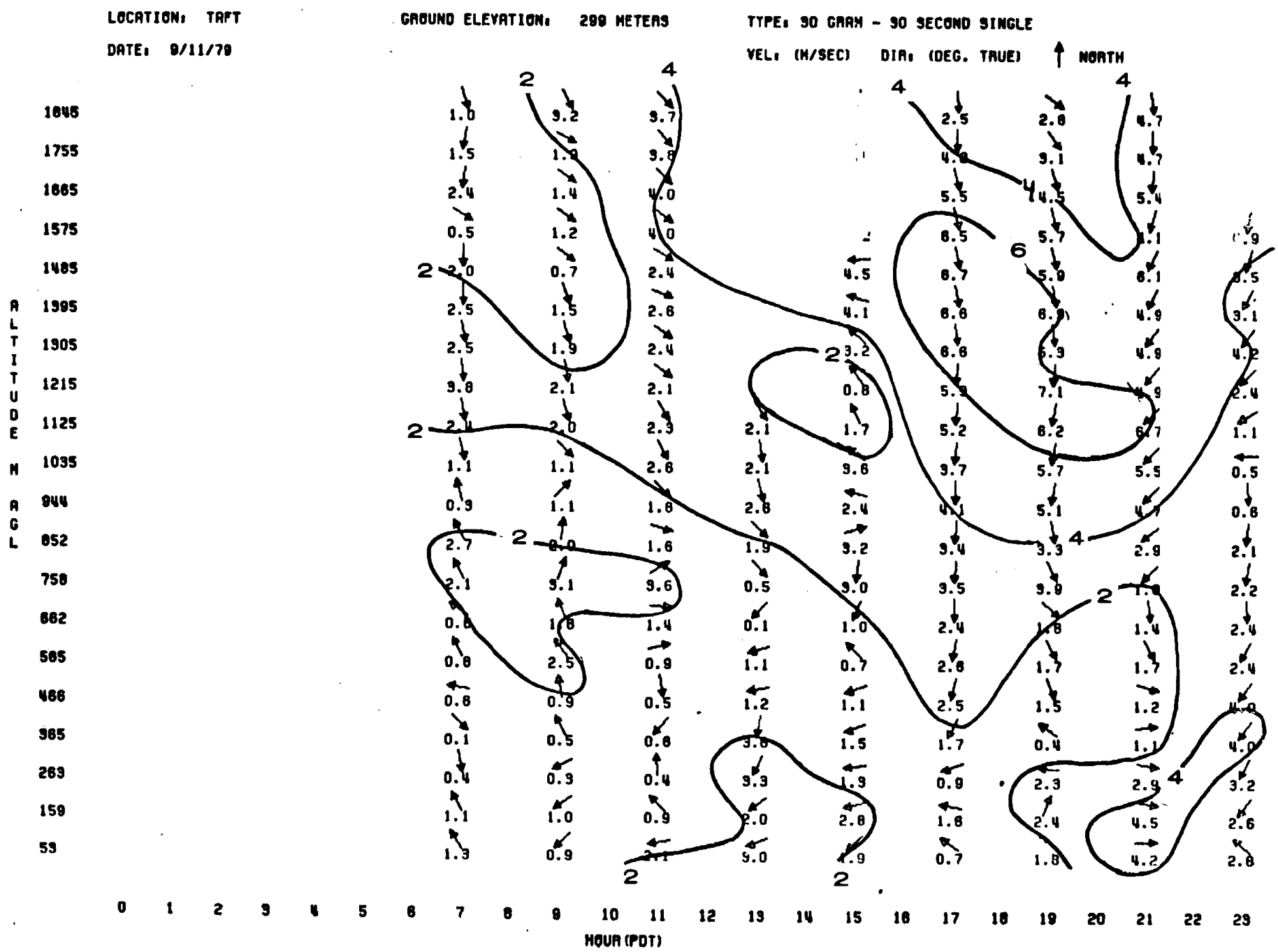


Figure 3.3.2 Time-Height Cross Section From Taft - 11 September 1979

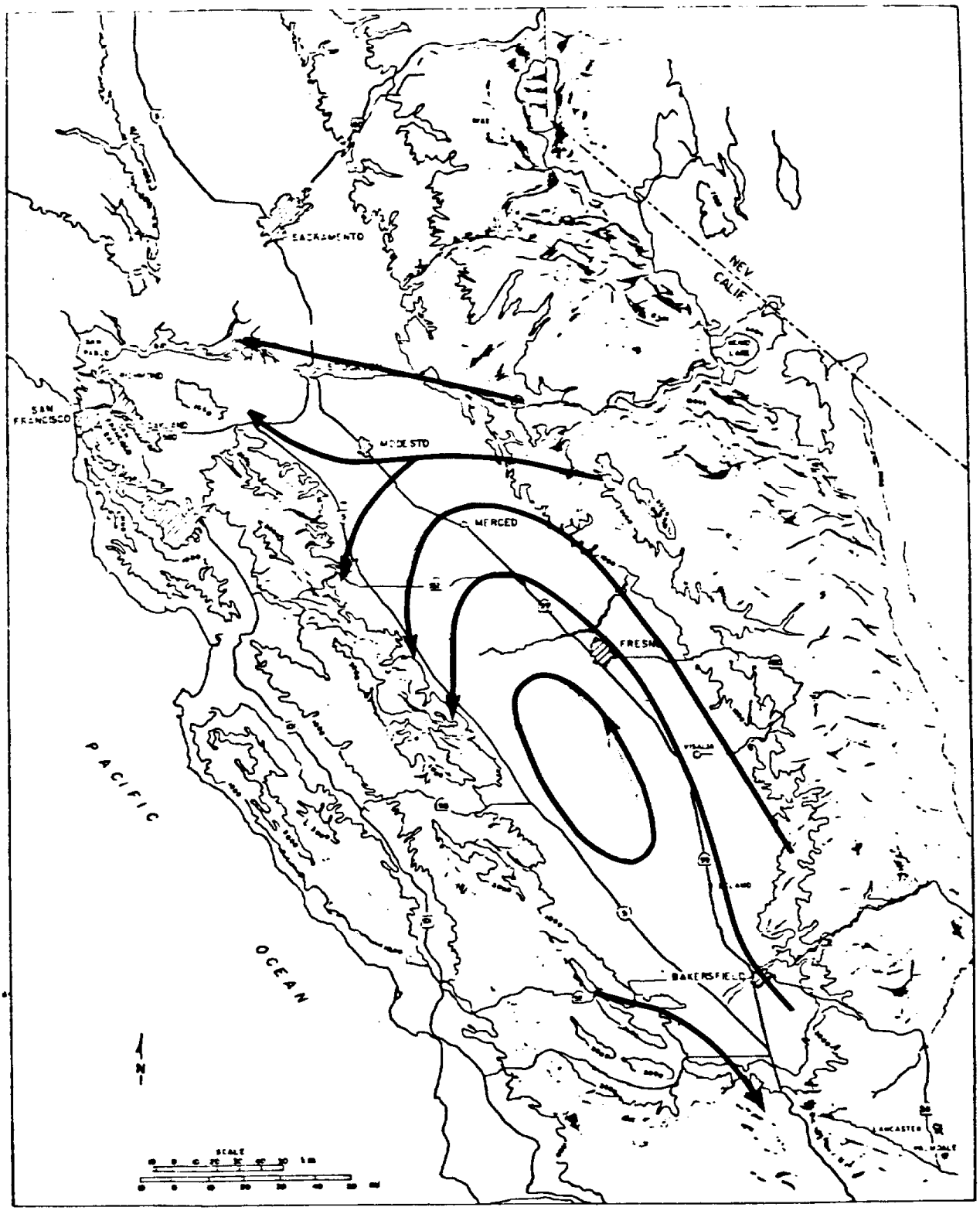


Figure 3.3.3 1000 Ft-agl Streamlines - 11 September 1979 (09 PDT)

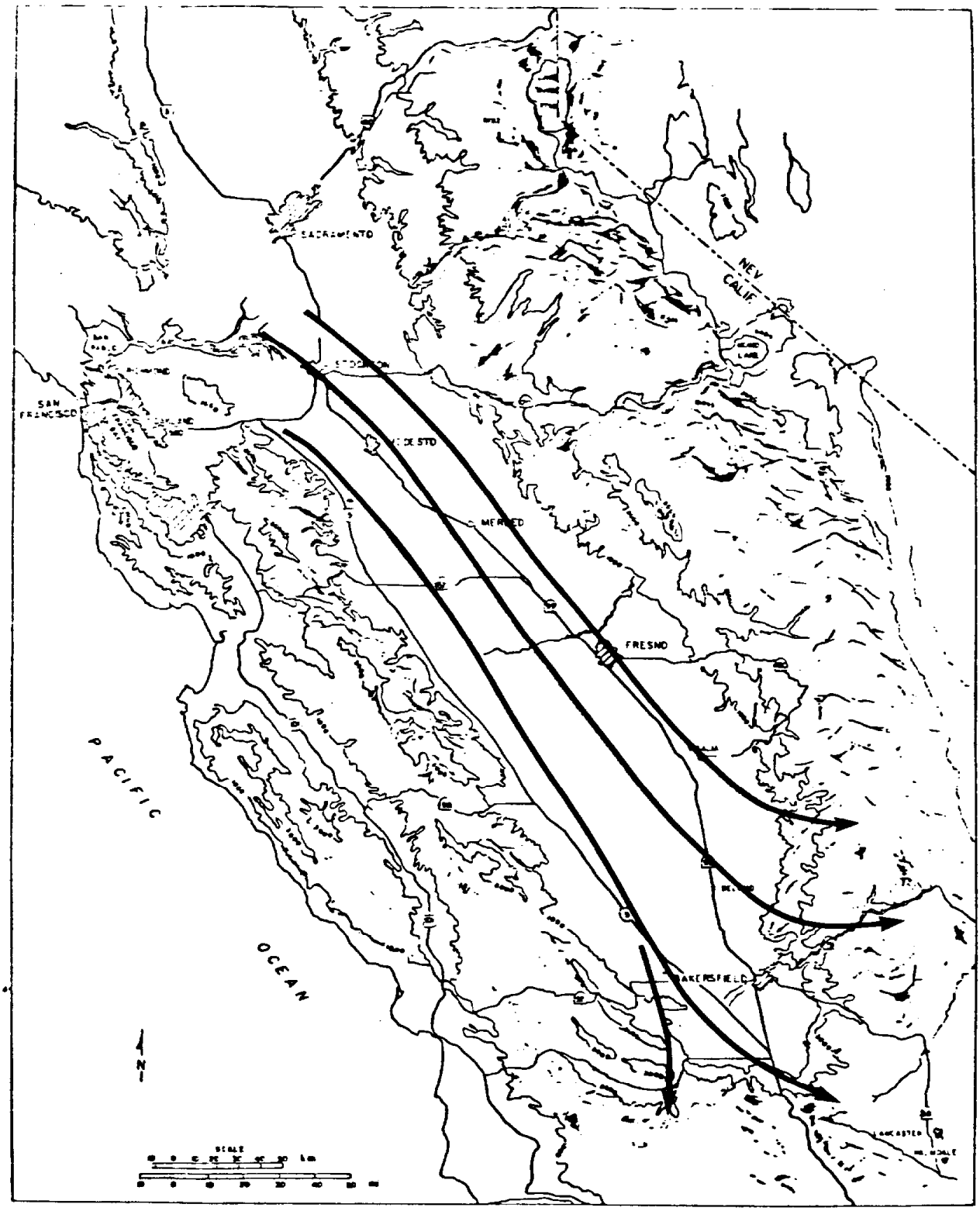


Figure 3.3.4 1000 Ft-agl Streamlines - 11 September 1979 (17 PDT)

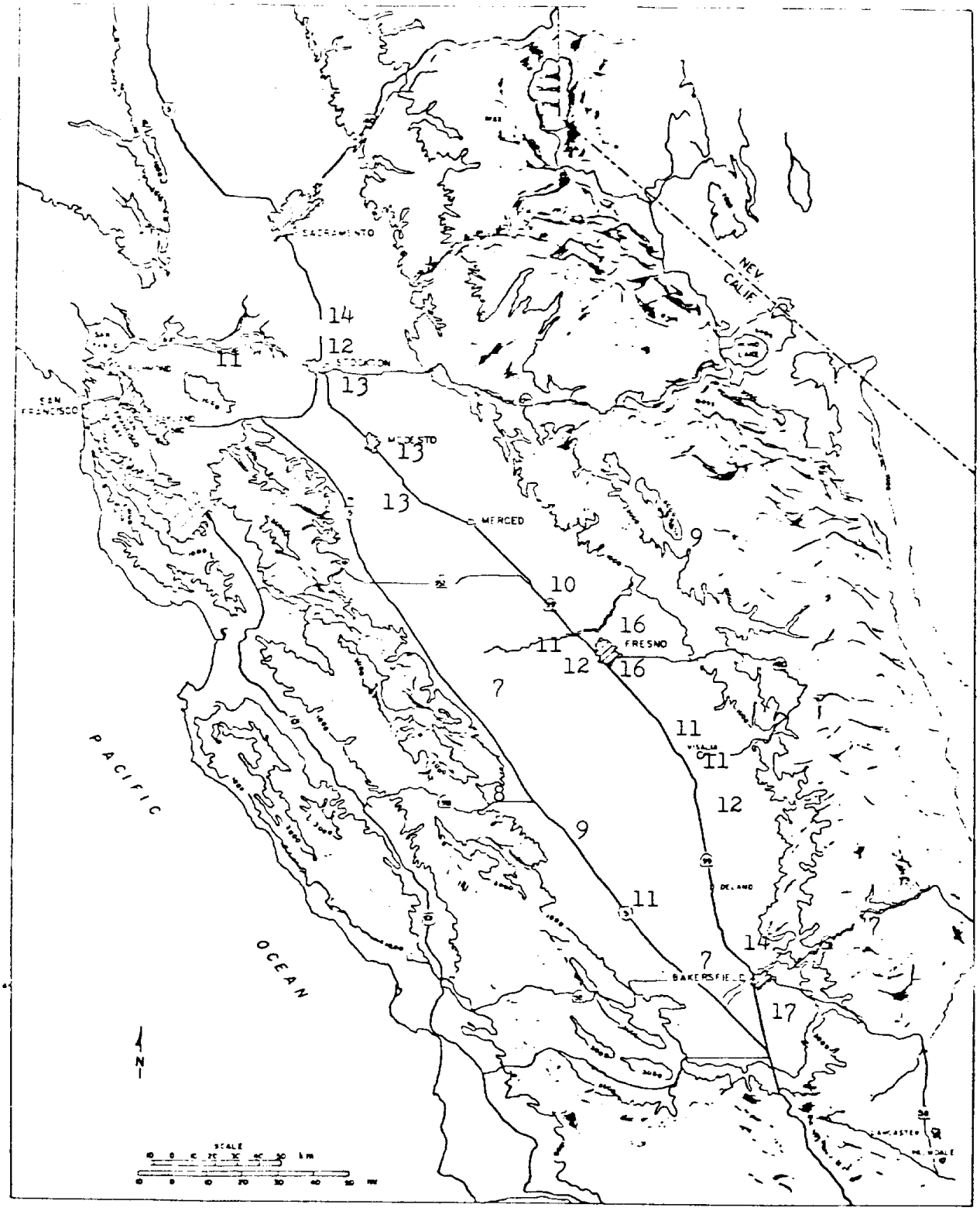


Figure 3.3.5 Maximum Hourly Ozone Concentrations (pphm) - 11 September 1979

Table 3.3.2

AIRCRAFT MIXING HEIGHTS

Time (PDT)	Location *	Mixing Height (m [above ground level])
	September 11, 1979	
1443	4 NW Bakersfield	750
1841	4 NW Bakersfield	660
	September 12, 1979	
0746	4 NW Bakersfield	150
0842	Caliente	220
0911	27 SSE Bakersfield	340
0948	Maricopa	370
1023	Wasco	350
1041	4 NW Bakersfield	420

* Distances in miles

Table 3.3.3 gives the maximum hourly concentrations of SO_2, CO and NO_x anywhere in the valley on September 11. Also shown are the maximum hourly values recorded at the three Rockwell International vans. Maximum levels of all pollutants were higher than observed during Tests 1 and 2 in keeping with the higher 850 mb temperatures and the increased stability aloft.

Aircraft Sampling

In conjunction with a tracer release from Fellows on the morning of the 11th, aircraft sampling took place in the afternoon (1441-1851 PDT) and again the following morning (0744-1106 PDT). The first flight consisted of a series of traverses within the surface mixing layer. This provided extensive aerial coverage of the southern portion of the San Joaquin Valley and the California Valley adjacent to the west side of the San Joaquin Valley. Spirals were flown at the start and end of sampling near Bakersfield to define the depth of mixing and to document temporal changes, if any. The following morning (12th) a series of spirals and traverses were flown primarily to measure tracer carry-over and distribution. Figure 3.3.6 shows the aircraft sampling route on September 11. Pollutant characteristics observed on various segments of the flight are given

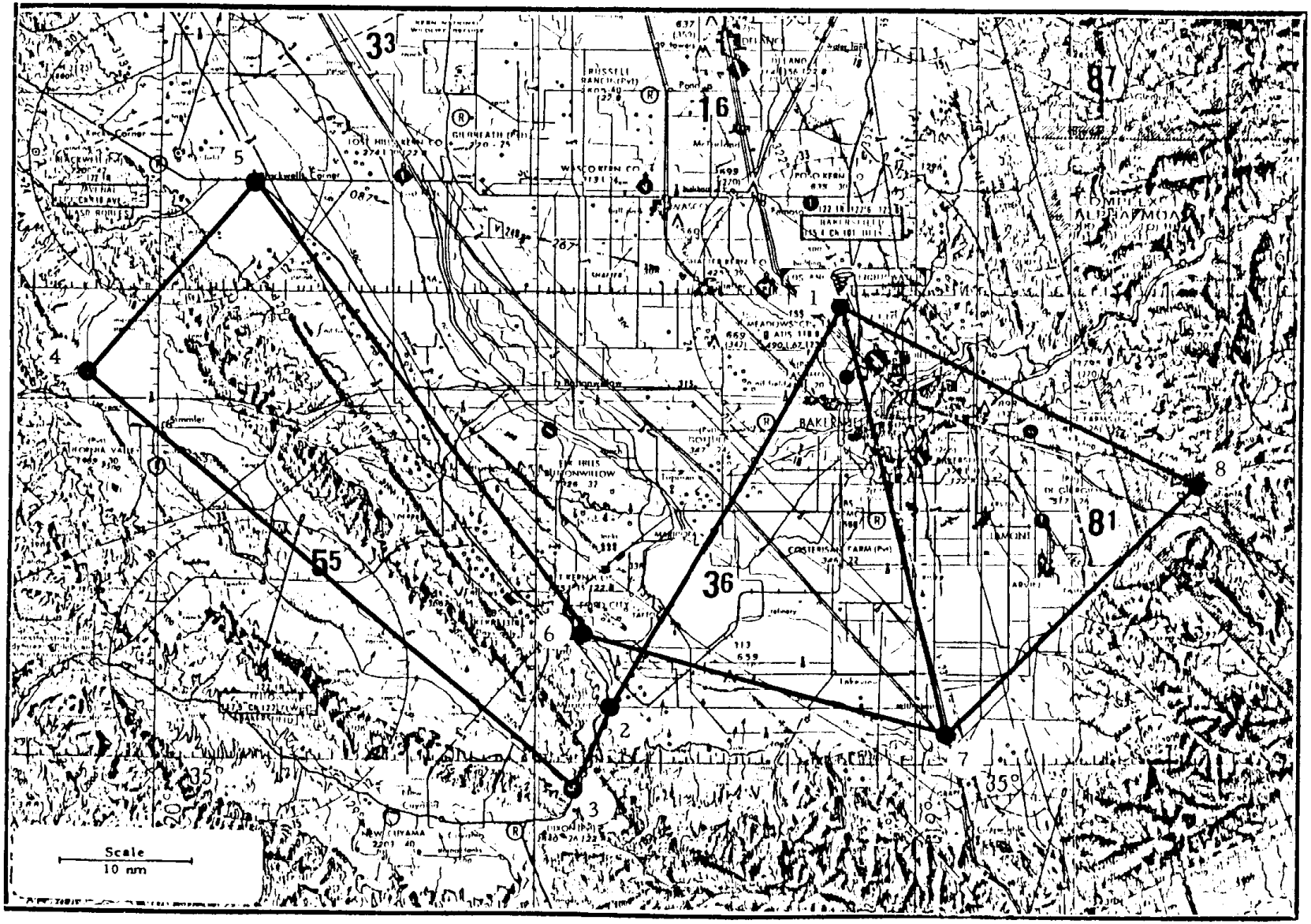
Table 3.3.3

MAXIMUM HOURLY CONCENTRATIONS
SEPTEMBER 11, 1979

Parameter	Location	Maximum Value (ppm)
SO_2	Bakersfield	.04
CO	Fresno-Olive	3
NO_x	Modesto	.29
NO_x	Fresno-L Street	.29
SO_2	Arvin (RI)	.01
SO_2	Lost Hills (RI)	.01
NO_x	Arvin (RI)	.02
NO_x	Lost Hills (RI)	.04
NO_x	Reedley (RI)	.02

in Table 3.3.4. Aircraft soundings made during the flight are reproduced in Figures 3.3.7 and 3.3.8. The sampling route on September 12 is shown in Figure 3.3.9 while Table 3.3.5 summarizes the pollutant concentration observed. Figures 3.3.10 to 3.3.14 show the sounding profiles for the flight.

On the afternoon flight, surface mixing extended through a 700 m layer in the valley and consequently visibilities were impaired by haze more than on the previous sampling days and ozone concentrations were generally increased. Within the urban air downwind of Bakersfield ozone levels in excess of .25 ppm were measured. Background and urban air concentrations of SO_2 and NO_x increased compared to previous test days but remained low. Considerable horizontal variability in ozone concentrations was encountered. For example, from Fellows to the intersection of I-5 and Highway 99 (1702 PDT) ozone ranged from .11 ppm to over .20 ppm. In the California Valley (1538 PDT), ozone levels ranged between .15-.20 ppm in the south and decreased to less than .10 ppm in the north end. Along the west foothills (1618 PDT), concentrations were about .14 ppm in the north (Point 5), and increased to greater than .23 ppm around Fellows (Point 6). Traversing NE from Point 7 along the southern extreme of



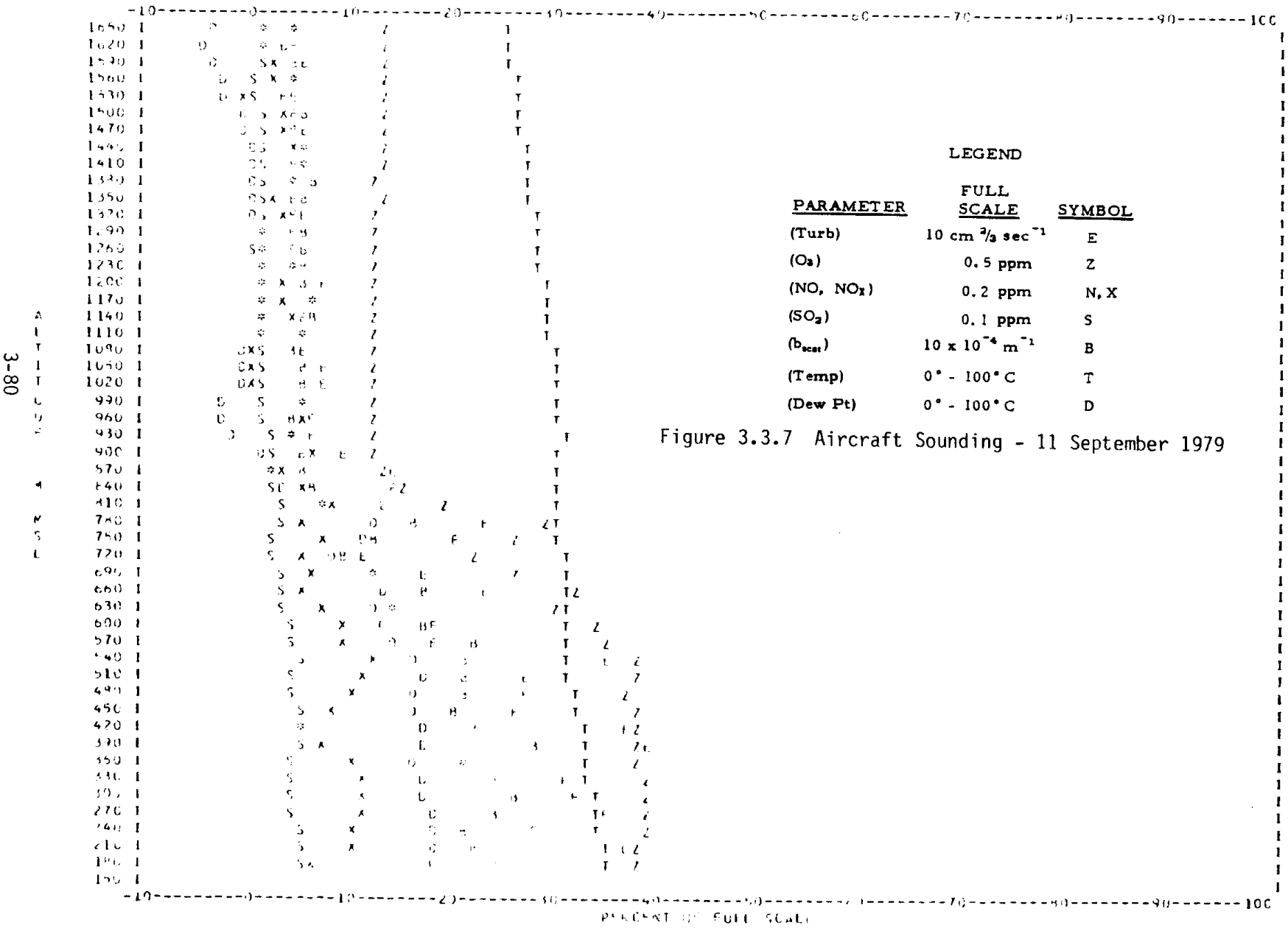
SAMPLING ROUTES 11 SEPTEMBER 1979

Figure 3.3.6

Table 3.3.4

AIR QUALITY MEASUREMENTS CARB SAN JOAQUIN VALLEY PROJECT
SEPTEMBER 11, 1979 SAMPLING

Start Time (PDT)	Location (Point)	O_3		b_{scat}		SO_2		NO_x		NO	
		Mean (ppb)	Max (ppb)	Mean ($x10^{-6}m^{-1}$)	Max	Mean (ppb)	Max (ppb)	Mean (ppb)	Max (ppb)	Mean (ppb)	Max (ppb)
1443	1	104	201	101	354	2	5	10	30	-	-
1511	1-2	160	197	145	240	2	8	12	24	-	-
1532	2-3	153	164	124	172	2	2	12	22	-	-
1538	3-4	123	198	99	184	2	12	10	25	-	-
1603	4-5	107	141	94	162	1	2	8	19	-	-
1618	5-6	167	233	149	226	3	12	13	33	-	-
1640	Fellows	182	220	142	284	3	4	28	100	-	-
1702	6-7	151	201	122	214	1	2	13	37	-	-
1718	7-1	151	186	137	216	3	36	16	81	-	-
1754	1-7	148	176	138	216	4	48	16	111	-	-
1811	7-8	215	259	222	352	7	11	18	36	-	-
1825	8-1	176	259	163	314	5	16	19	39	-	-
1842	1	124	171	110	204	2	3	11	28	-	-



LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec $^{-1}$	E
(O_3)	0.5 ppm	Z
(NO, NO_X)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100°C	T
(Dew Pt)	0° - 100°C	D

Figure 3.3.7 Aircraft Sounding - 11 September 1979

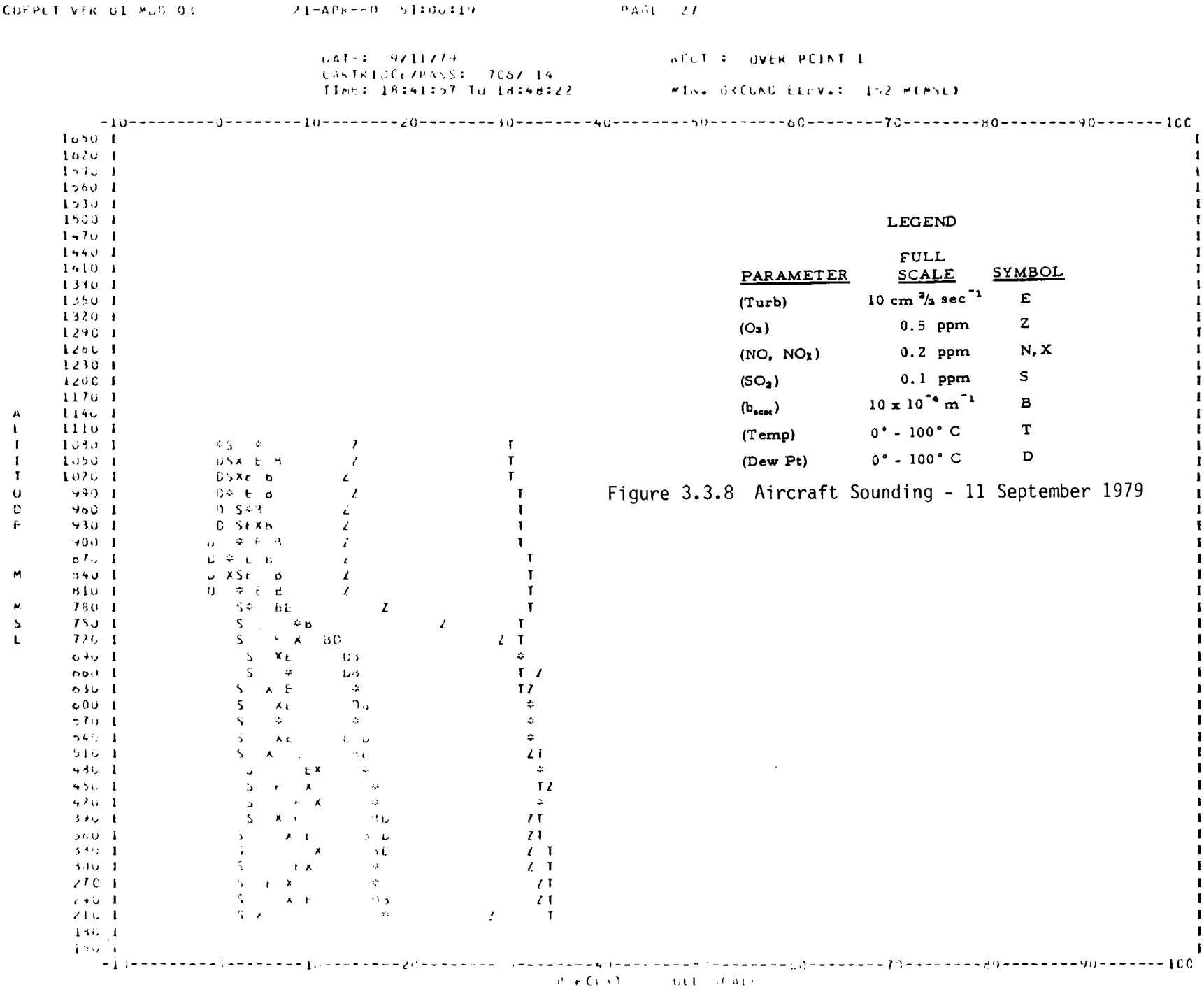
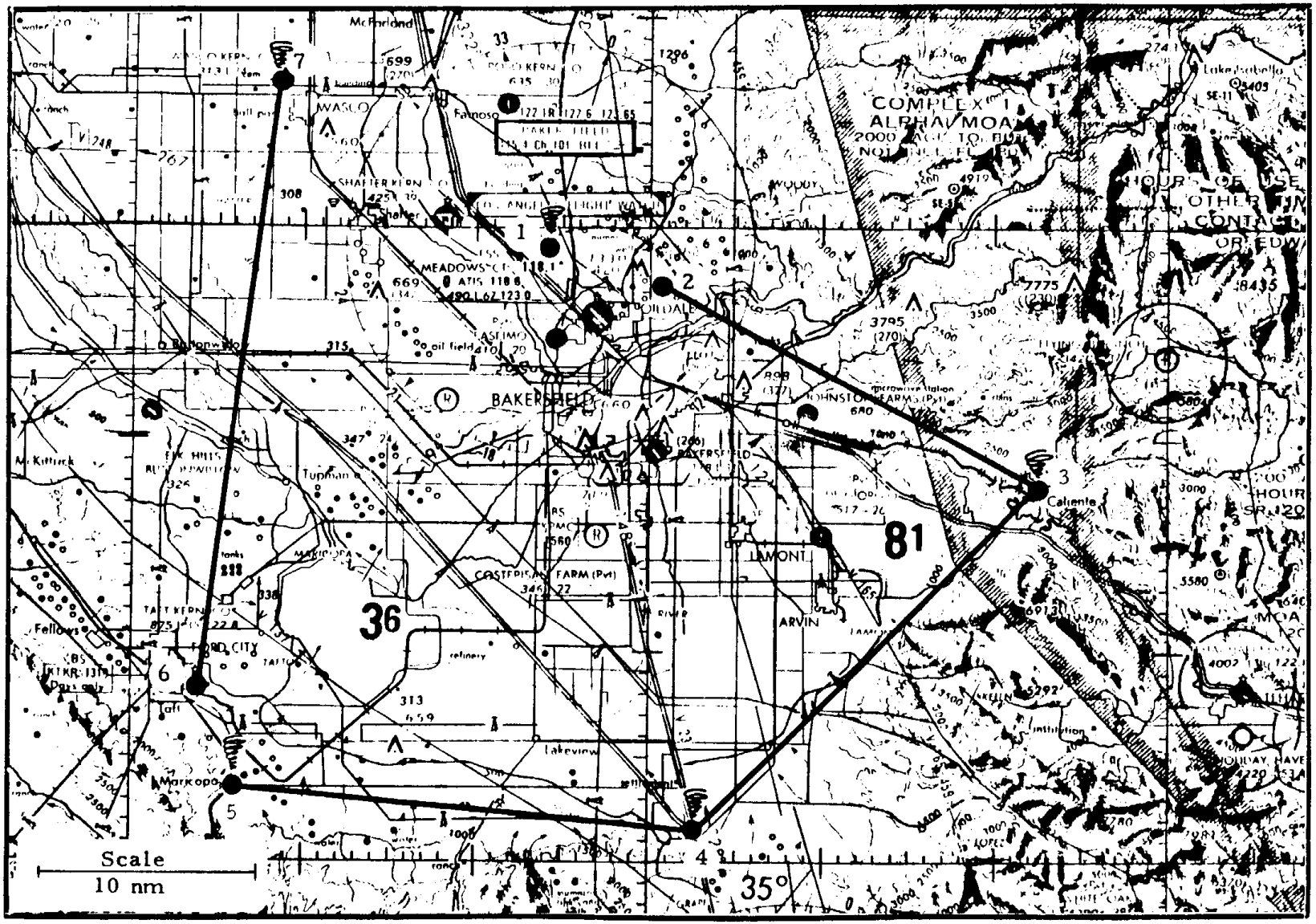


Figure 3.3.8 Aircraft Sounding - 11 September 1979



SAMPLING ROUTES 12 SEPTEMBER 1979

Figure 3.3.9

Table 3.3.5

AIR QUALITY MEASUREMENTS CARB SAN JOAQUIN VALLEY PROJECT
SEPTEMBER 12, 1979 SAMPLING

Start Time (PDT)	Location (Point)	O_3		b_{scat}		SO_2		NO_x		NO	
		Mean (ppb)	Max (ppb)	Mean ($x10^{-6}m^{-1}$)	Max	Mean (ppb)	Max (ppb)	Mean (ppb)	Max (ppb)	Mean (ppb)	Max (ppb)
0747	1	104	178	117	388	4	79	5	34	3	15
0823	Oil Fields	34	118	278	1602	156	224	175	381	-	-
0827	2-3	122	150	170	276	8	73	12	101	4	57
0843	3	116	147	105	182	1	3	8	57	-	-
0858	3-4	100	136	84	222	1	2	5	14	-	-
0911	4	113	153	101	126	1	4	6	28	-	-
0932	4-5	121	141	107	166	1	2	5	15	-	-
0948	5	106	145	100	128	3	32	7	38	-	-
1003	6-7	114	141	80	150	1	1	5	15	3	18
1024	7	110	182	103	298	3	12	9	32	-	-
1042	1	122	188	108	308	2	8	10	59	-	-

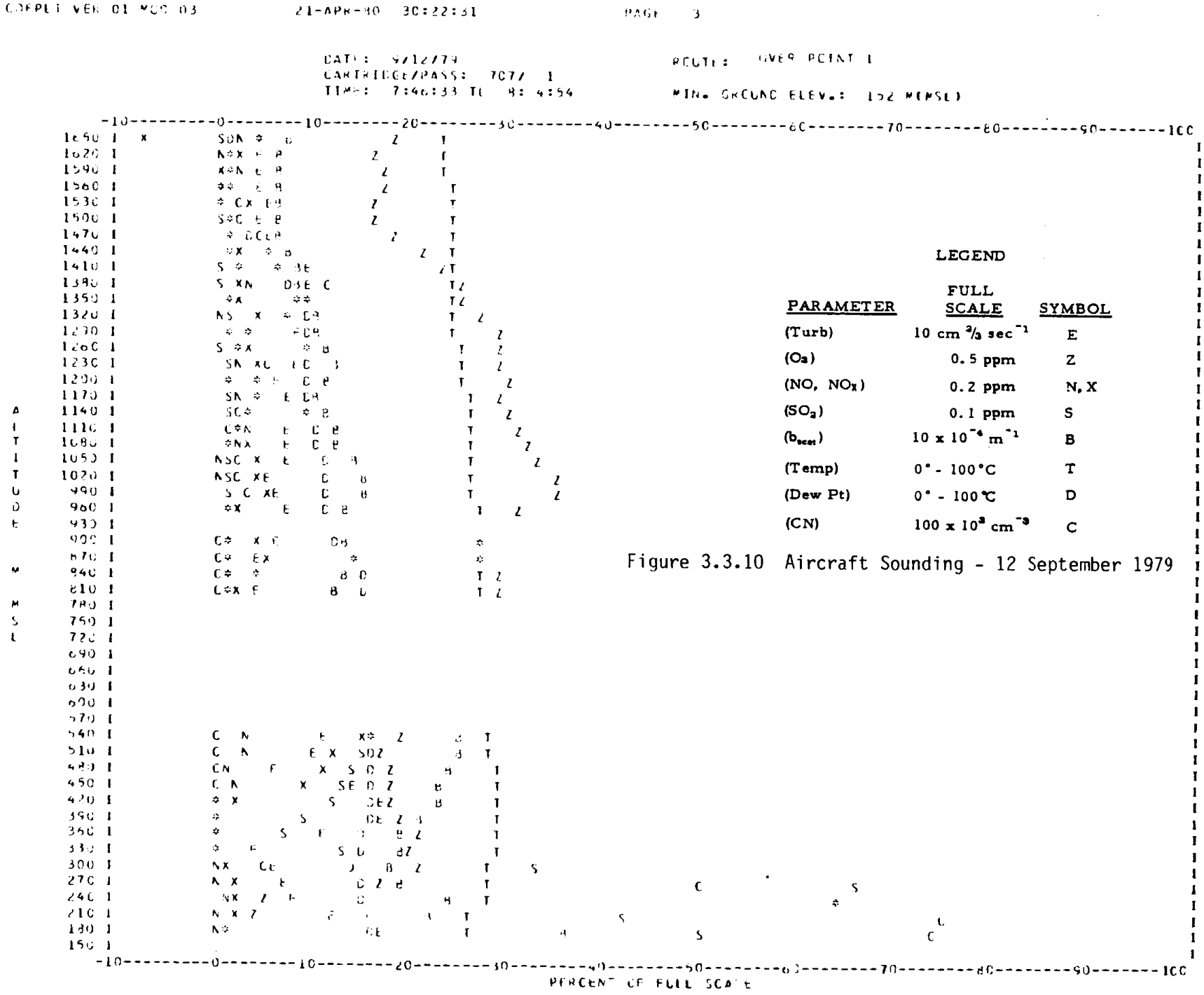
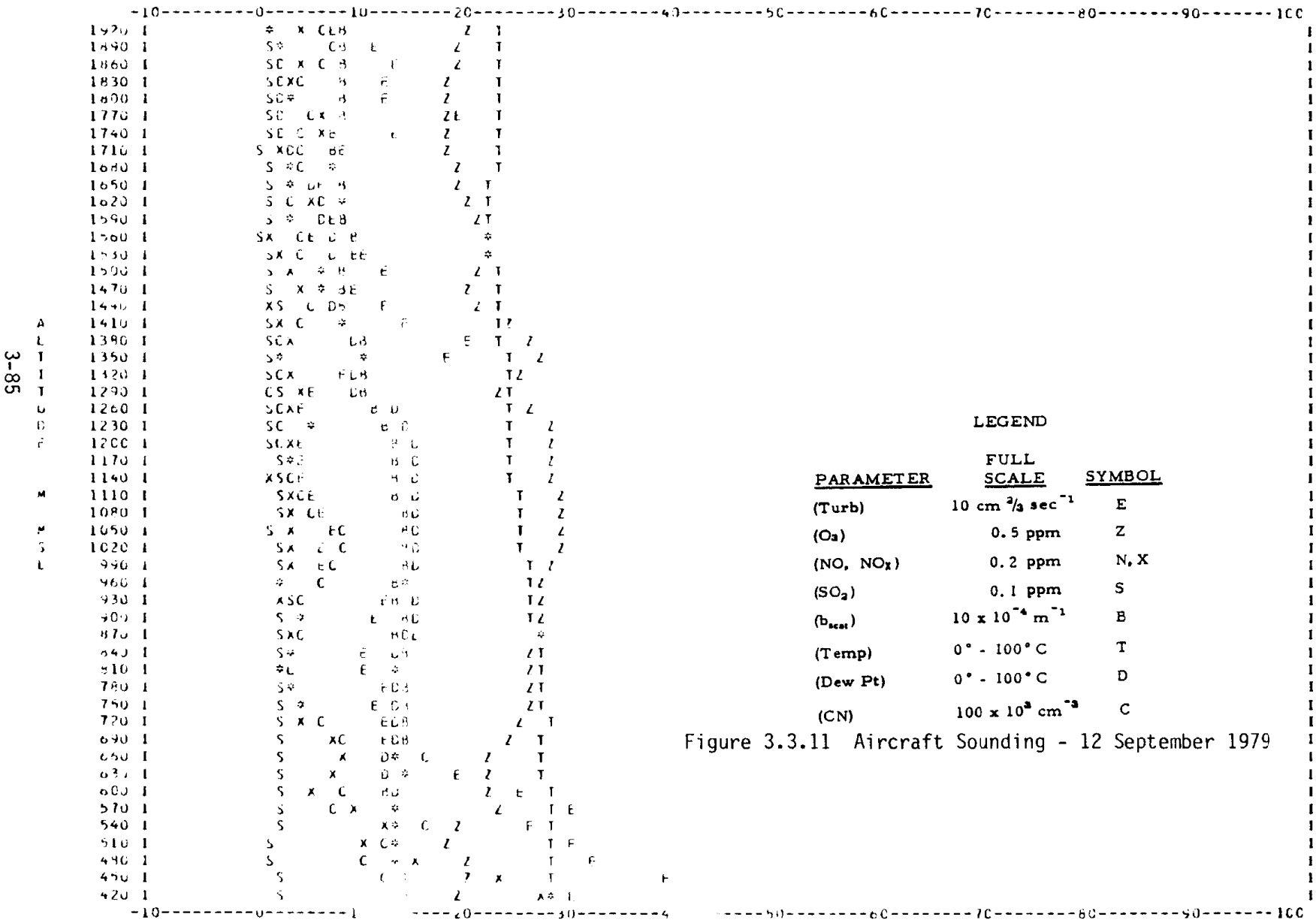


Figure 3.3.10 Aircraft Sounding - 12 September 1979

DATE: 9/12/79 ROUTE: OVER POINT A
CARTRIDGE/PASS: 7077 5
TIME: 8:42:52 TO 8:54:24 MIN. GROUND ELEV.: 426 M(MSL)



LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec^{-1}	E
(O_3)	0.5 ppm	Z
(NO, NO_X)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100° C	T
(Dew Pt)	0° - 100° C	D
(CN)	100 x 10^{3} cm^{-3}	C

Figure 3.3.11 Aircraft Sounding - 12 September 1979

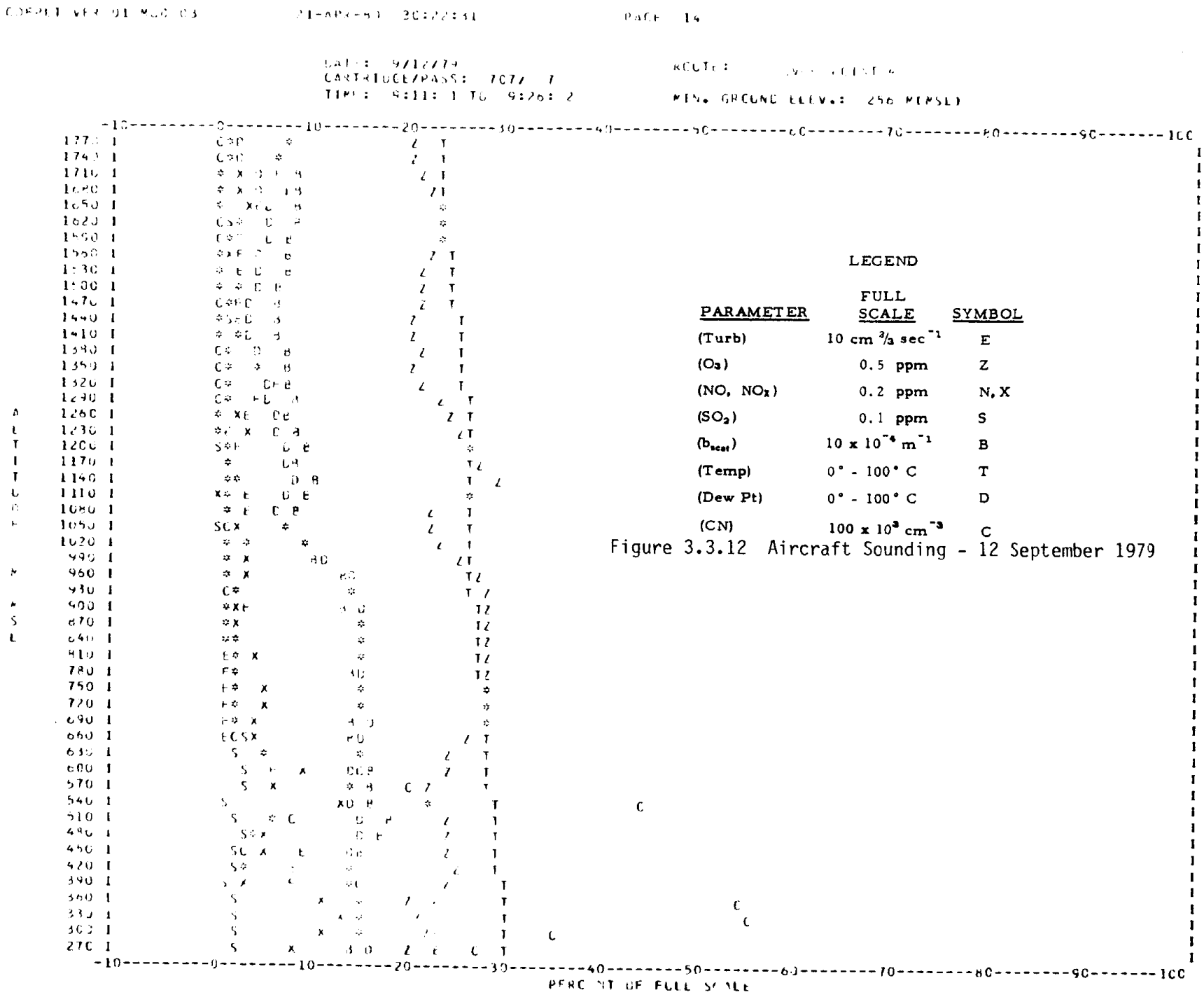
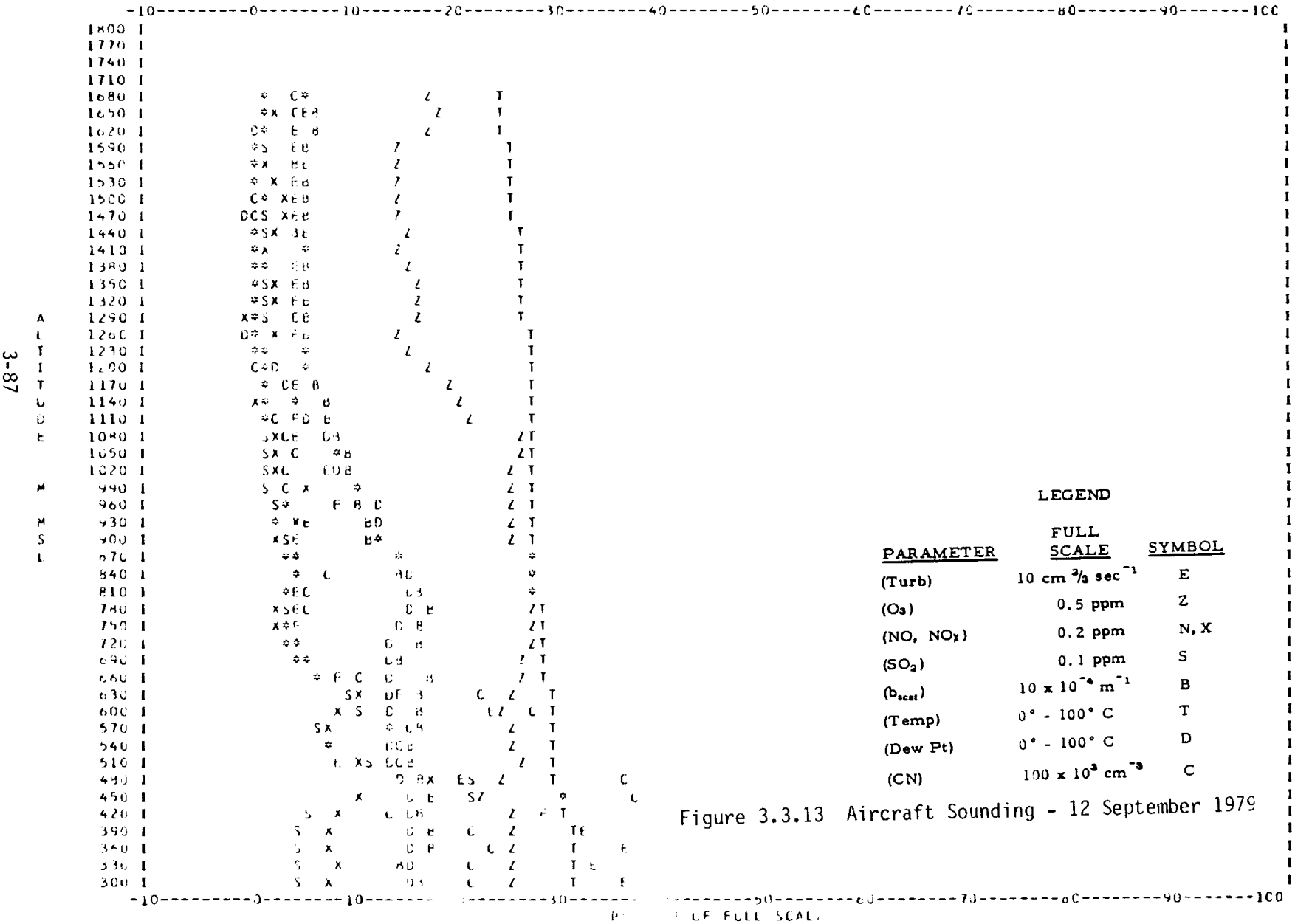


Figure 3.3.12 Aircraft Sounding - 12 September 1979

DATE: 9/12/79 ROUTE:
CARTRIDGE/PASS: 7077 9
TIME: 9:48:11 TO 9:56:16 MIN. GROUND ELEV.: 286 M(MSL)



LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec^{-1}	E
(O_3)	0.5 ppm	Z
(NO, NO_x)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100° C	T
(Dew Pt)	0° - 100° C	D
(CN)	100 x 10^{3} cm^{-3}	C

Figure 3.3.13 Aircraft Sounding - 12 September 1979

DATE: 9/12/79
CARTRIDGE/PASS: 7677 11
TIME: 10:23:55 TO 10:35:14

PLOT: [illegible]
MIN. GROUND ELEV.: 94 M(MSL)

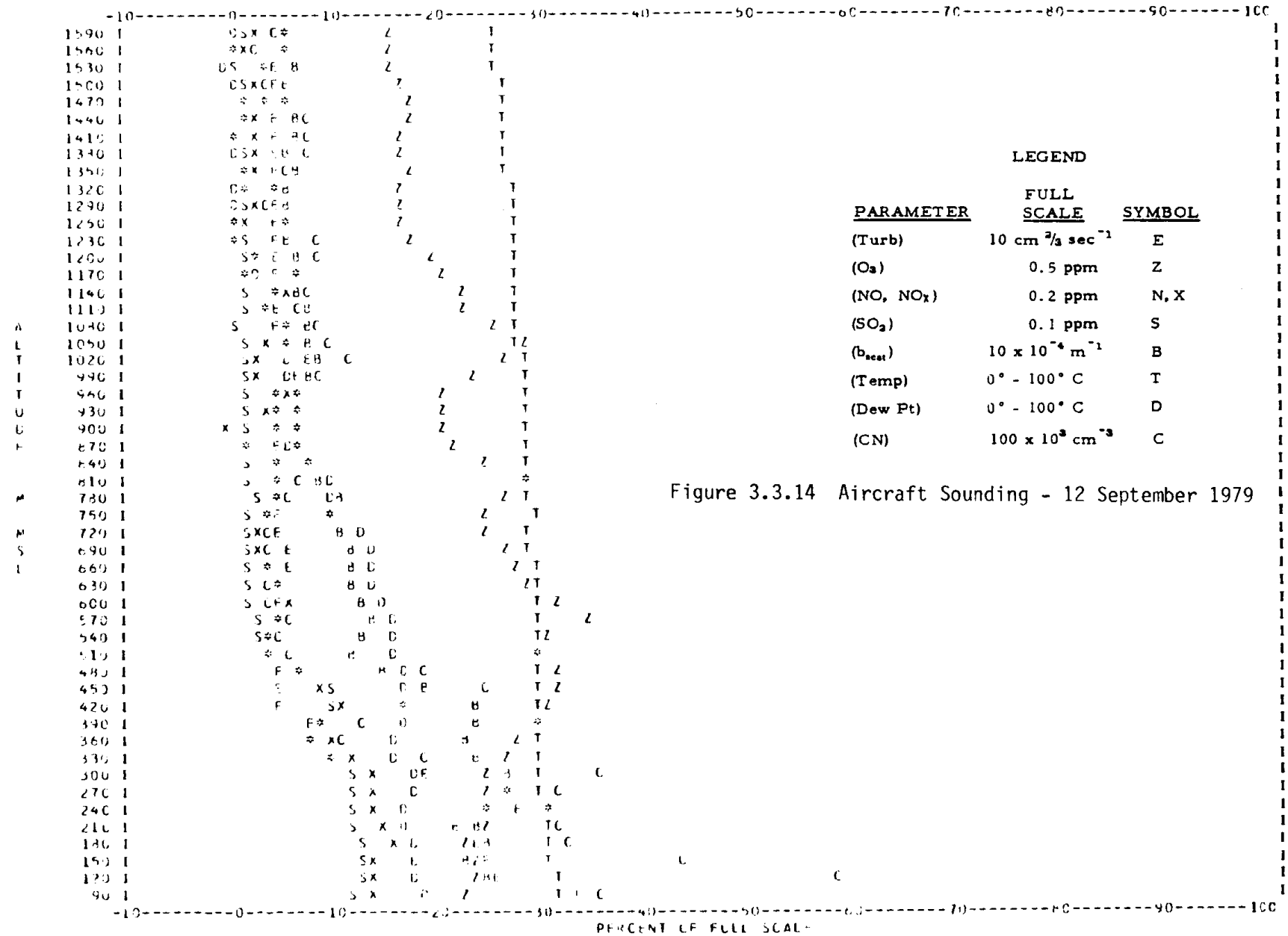


Figure 3.3.14 Aircraft Sounding - 12 September 1979

the valley background levels of about .10 ppm increased sharply to concentrations greater than .25 ppm in the downwind urban plume. The oil fields in the vicinity of Fellows were orbited at 1640 PDT and unexpectedly low concentration of SO_2 were measured. However, moderate levels of NO_x (.10 ppm) and high concentrations of ozone (.22 ppm) were observed.

The greatest SO_2 concentrations (.05 ppm) encountered were in the vicinity of the refinery source in west Bakersfield which had been identified on several previous sampling missions.

The sounding made near Bakersfield at 1443 PDT shows a deep ozone layer (.20 ppm) from the surface to 360 m above ground level. Top of the mixing layer was sharply defined at 870 m (msl). Clean air was present above the mixing layer.

By 1841 PDT at Bakersfield (Figure 3.3.8), the ozone layer was slightly shallower and the ozone concentrations in the layer were slightly reduced. Otherwise, there was little difference between the two soundings.

On the following morning's flight, high background ozone concentrations remained, over .10 ppm along all sampling routes. Concentrations in excess of .18 ppm were measured aloft over Wasco and Bakersfield and .10 ppm ozone concentrations were present to over 1400 m (msl) over Bakersfield. Background SO_2 and NO_x levels remained low above the nocturnal stable layer. An orbit was made at 0823 PDT over the oil fields near Oildale within the stable layer. Average concentrations of SO_2 and NO_x were in excess of .15 ppm and .17 ppm, respectively. Peak concentrations of .22 ppm and .38 ppm SO_2 and NO_x respectively were recorded.

Figure 3.3.10 was made at 0746 PDT near Bakersfield on the following morning. High ozone concentrations (.10 ppm or more) extended to over 1400 m (msl), much higher than the previous evening. It is apparent that a considerable layer of ozone (peak concentration .18 ppm) was advected into the area aloft during the night. A shallow, low level mixing layer was characterized by SO_2 values to .07 ppm.

A sounding made near Caliente at 0842 PDT (Figure 3.3.11) showed a depleted layer of ozone in the lowest 300 m but with higher ozone concentrations aloft (peak .15 ppm). No significant SO_2 was observed in the low levels, verifying the local nature of the high SO_2 concentrations near Bakersfield.

Figure 3.3.12 shows the profile made near the intersection of Highways 99 and I-5 at 0911 PDT. Ozone concentrations of .10 to .15 ppm were present at all levels but with a tendency for layering to occur. The sounding was similar to Figure 3.3.11 and showed only minimal amounts of SO_2.

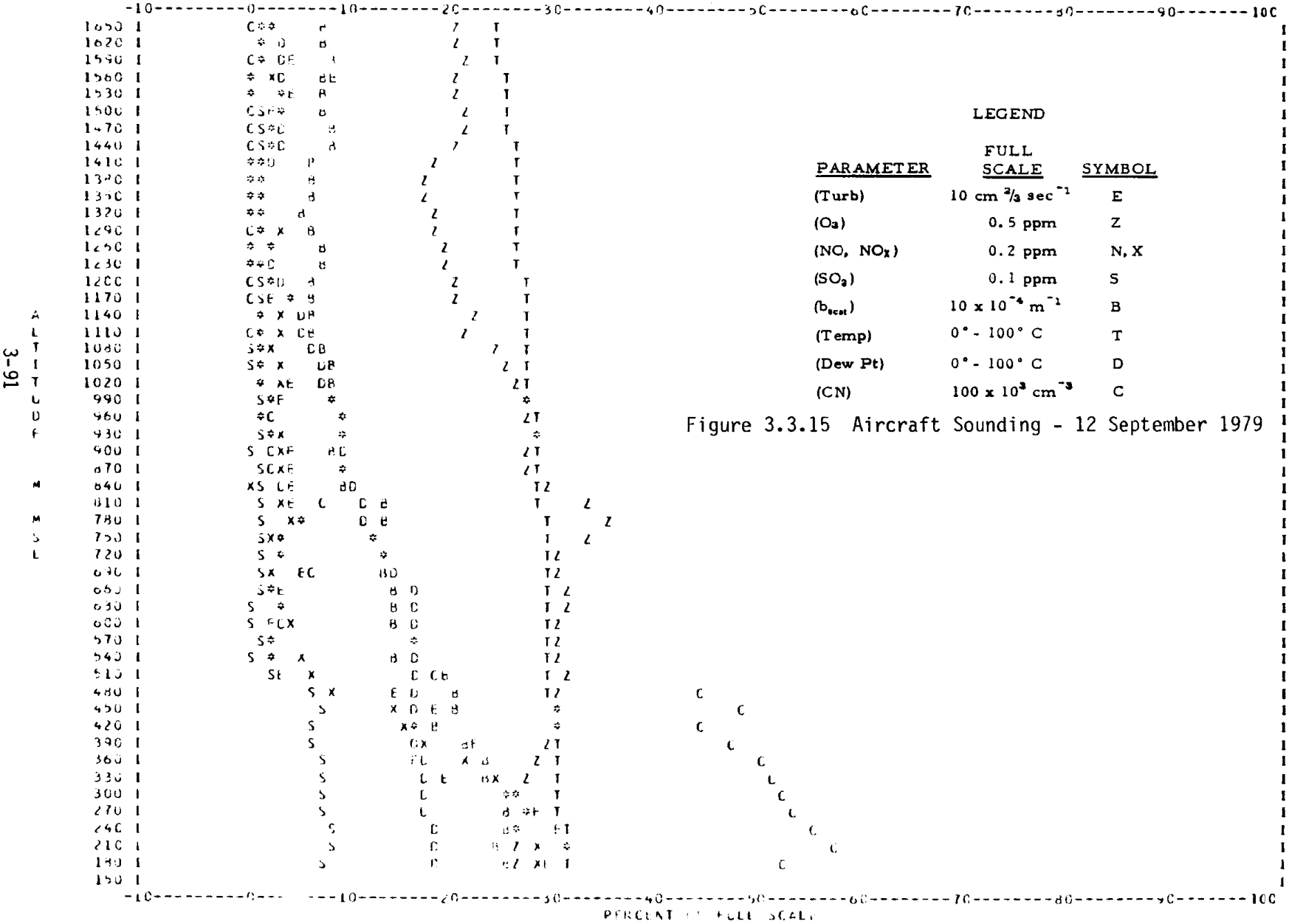
The sounding in Figure 3.3.13 was made near Maricopa at 0956 PDT. Peak ozone concentrations in the lowest 800 m was about .14 ppm but a much cleaner layer existed above 1260 m (msl). This suggests an east-west gradient in ozone concentrations at higher levels although more areal uniformity was observed below 1000 m (msl).

Figure 3.3.14 gives the sounding made near Wasco at 1023 PDT. There is considerable similarity in the ozone profiles with the west and southern part of the valley. Ozone concentrations below 870 m (msl) were slightly higher at Wasco but concentrations aloft were more similar. It is to be noted that the peak ozone concentration at Wasco (.17 ppm) occurred at 570 m (msl) which is above the surface mixing layer.

At 1041 PDT (Figure 3.3.15), the final sounding was made near Bakersfield. A marked reduction in the low level SO_2 concentrations was apparent from Figure 3.3.10 in response to a deepening in the surface mixing layer and probable changes in air trajectories. Peak ozone concentration recorded was .17 ppm at 780 m (msl) which was above the surface mixing layer. Concentrations aloft were similar to those observed in the western and southern portions of the valley.

An interesting feature of the series of soundings on September 11-12 is the marked increase in ozone concentrations aloft during the night at Bakersfield. Winds in the layer affected were northwest through 0100 PDT (12th) and shifted to southwest from 0300 to 0700 PDT in response to the eddy formation. Since the afternoon mixing layer did not extend as high as the morning ozone layer was observed, another mechanism must be responsible for the transport of ozone to higher levels.

DATE: 9/12/79 ROUTE: OVER POINT 1
CARTRIDGE/PASS: 7077 12
TIME: 10:41:42 TO 10:54:13 MIN. GROUND ELEV.: 152 M(MSL)



LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec $^{-1}$	E
(O_3)	0.5 ppm	Z
(NO, NO_X)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m $^{-1}$	B
(Temp)	0° - 100° C	T
(Dew Pt)	0° - 100° C	D
(CN)	100 x 10^3 cm $^{-3}$	C

Figure 3.3.15 Aircraft Sounding - 12 September 1979

3.3.3 Tracer Test 3

Release Location: Fellows, Kern County
Time and Date: 0700-1200 PDT, 9/11/79
Release Amount: 108 lbs SF6/hr
Release conducted during generally easterly winds. Westward, out-of-valley transport continued throughout the day of the release.

Initial Transport

Even though the surface winds at the release site were predominantly from the east, some of the released tracer was detected north of the release site. As shown in Figure 3.3.16, tracer was detected both in the vicinity of the release site and west of Buttonwillow during Traverses 1-1 and 1-2. The concentrations detected near Fellows (maximum of about 2000 PPT) were about 2 orders of magnitude larger than the concentrations detected near Buttonwillow (maximum of about 50 PPT). Apparently very little material was transported north of the release site. Essentially no tracer was detected near Buttonwillow after about 1030 PDT. It was not possible to correlate the presence of the small amount of tracer near Buttonwillow with wind conditions at the release site. Essentially none of the tracer released was transported to other sites within the San Joaquin Valley. Figure 3.3.17 shows that only low, background levels of the tracer could be detected at all hourly-averaged sampler locations within the valley. The non-zero background concentrations detected at most of the sites was probably due to the previous tracer releases.

Since only a small amount of the tracer could be accounted for within the San Joaquin Valley, the majority of the tracer was presumably transported by the prevailing winds towards the west. Essentially no SF6 was detected, however, during automobile traverses conducted west of the Temblor Mountains, the first range of mountains west of the release site. It is possible that the typical afternoon onshore flow along the coast led to the development of a converging flow at the mountains on the western edge of the San Joaquin Valley. The convergence of a westerly flow from the coast and an easterly flow from the San Joaquin Valley probably carried the tracer aloft. The vertical mixing above Taft on the extreme western edge of the San Joaquin Valley appeared to

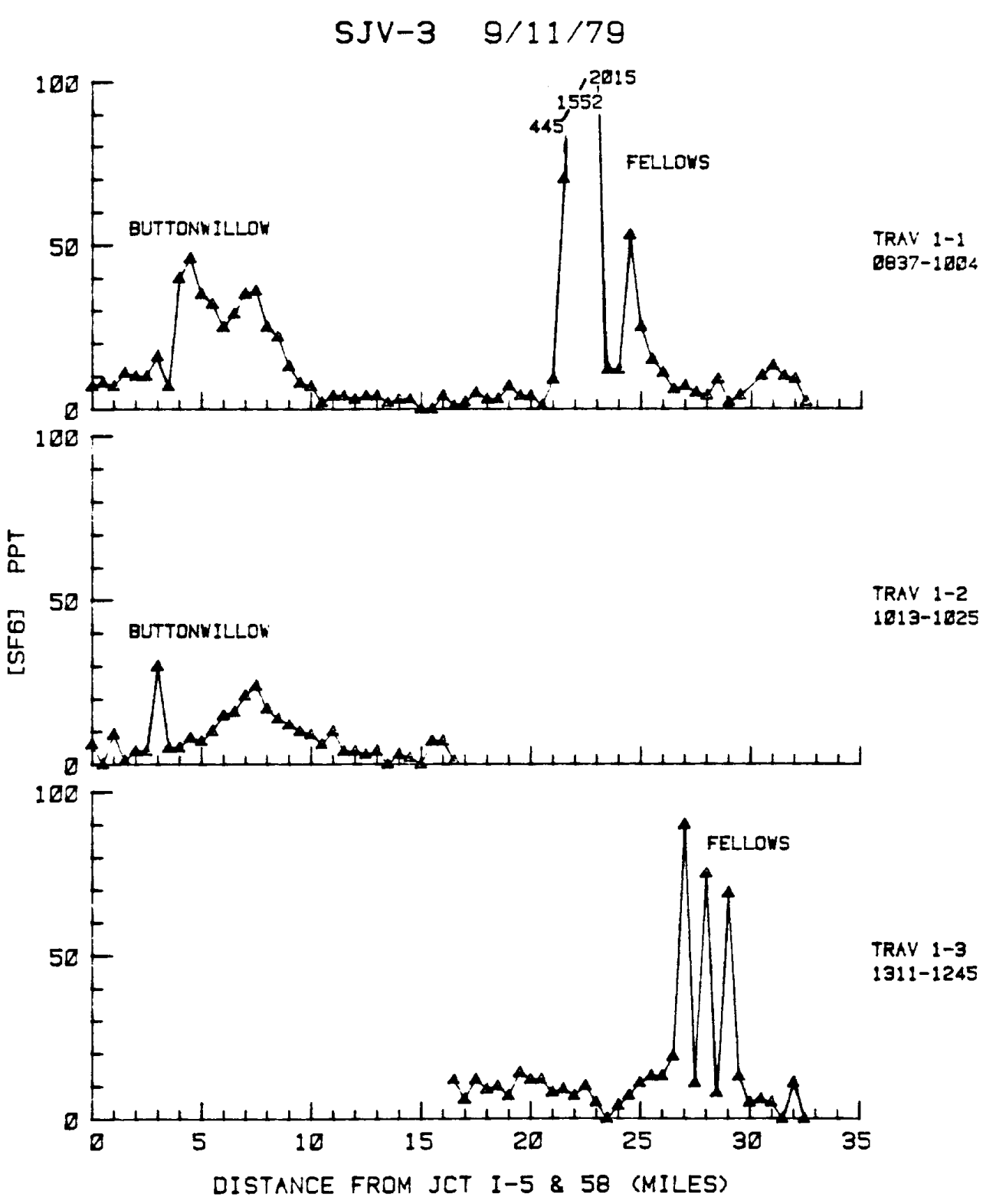
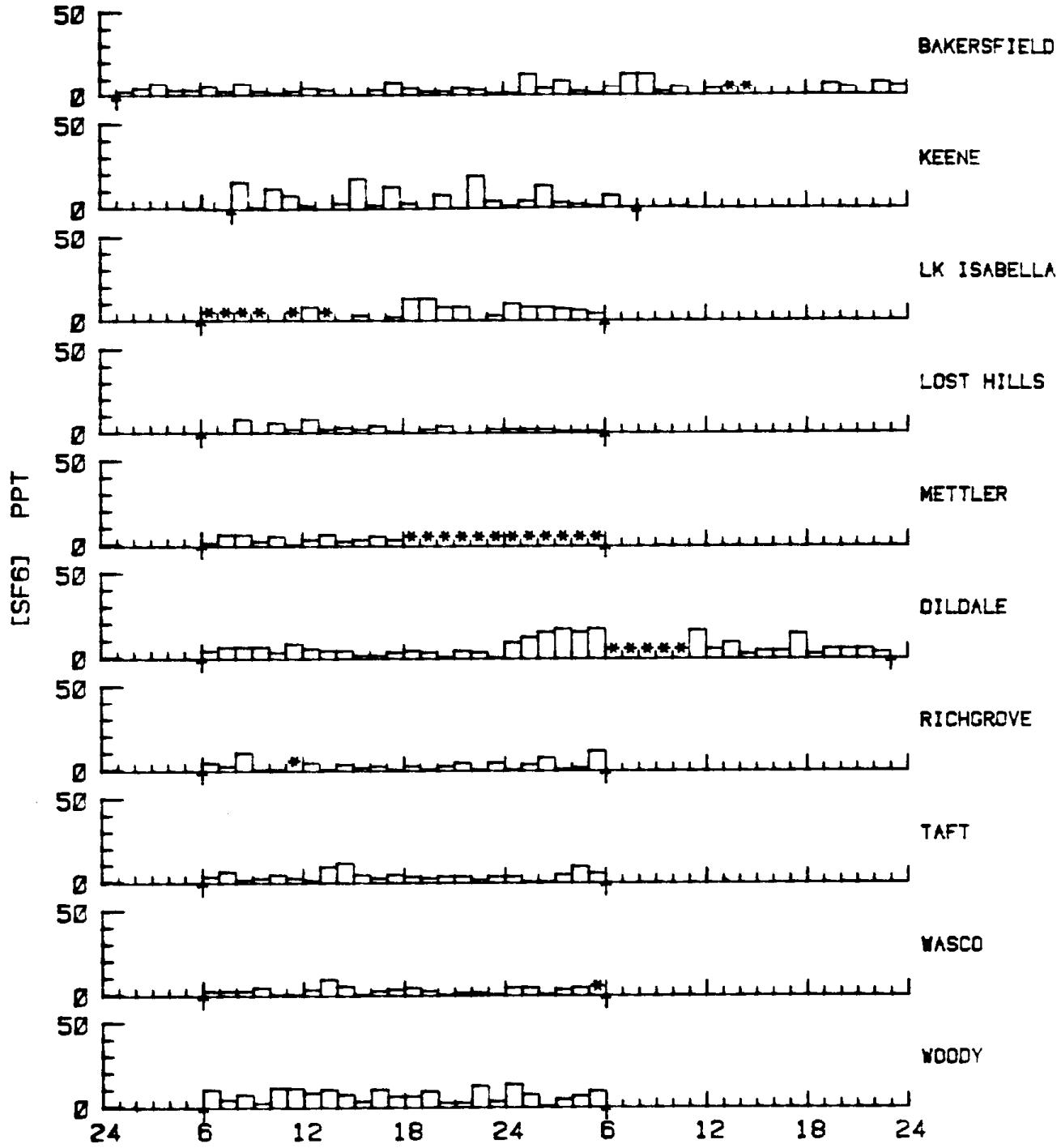

SJV-3 9/11/79
100
50
0
2015
1552
445
FELLOWS
BUTTONWILLOW
TRAV 1-1
0837-1004
100
50
0
[SF6] PPT
BUTTONWILLOW
TRAV 1-2
1013-1025
100
50
0
FELLOWS
TRAV 1-3
1311-1245
0
5
10
15
20
25
30
35
DISTANCE FROM JCT I-5 & 58 (MILES)
TRAVERSE ROUTE: WEST ON 58; SOUTH ON 33 TO 119 (TAFT)
RELEASE LOCATION: 540 # SF6 AT FELLOWS
RELEASE TIME: 0700-1200 PDT, 9/11/79

Figure 3.3.16

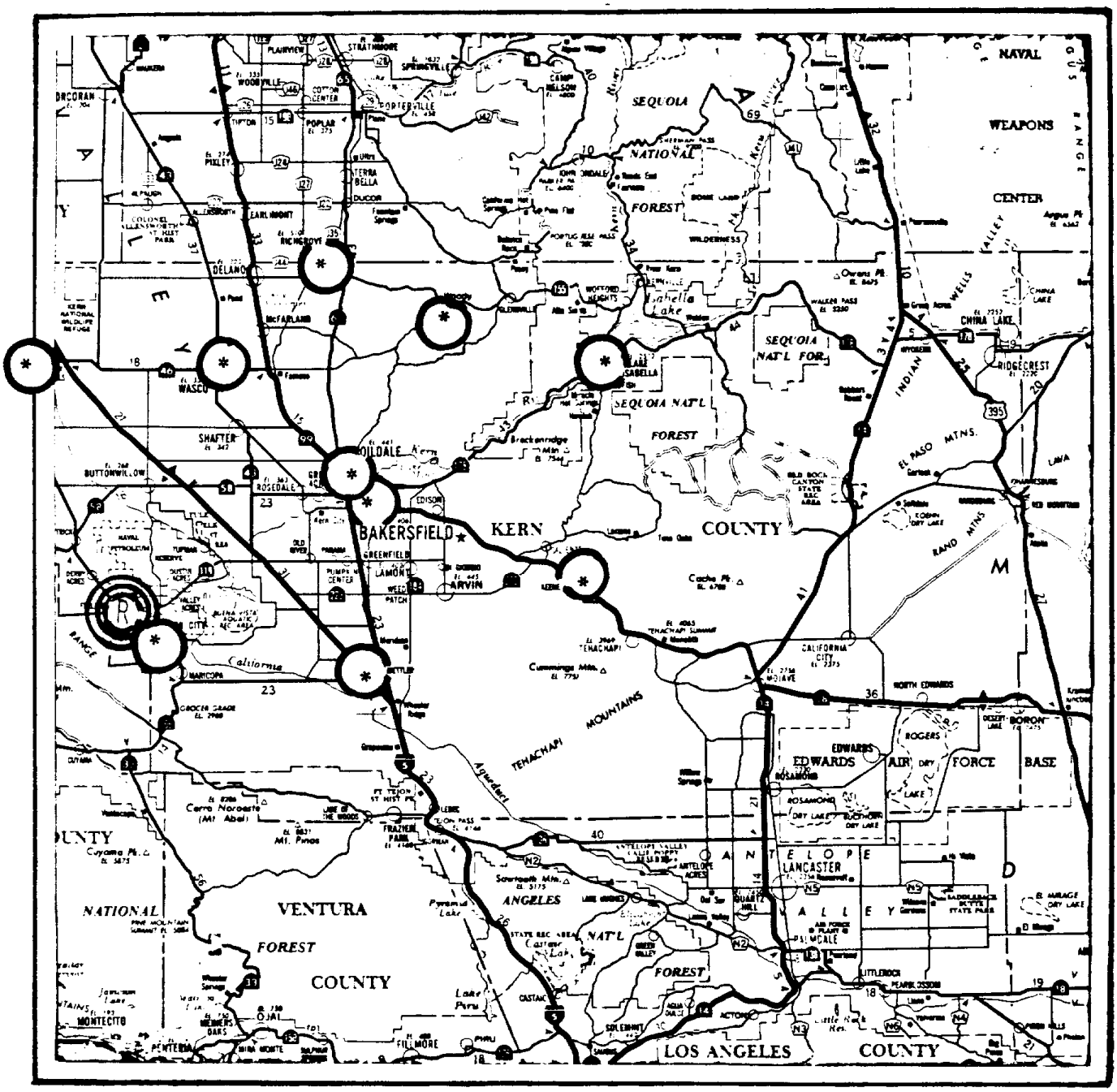


RELEASE LOCATION: 540 # SF6 AT FELLOWS
RELEASE TIME: 0700-1200 PDT, 9/11/79

* INDICATES MISSING DATA
ARROWS INDICATE BOUNDS OF SAMPLING PERIOD

Figure 3.3.17

SJV
3



(*) INDICATES SAMPLER LOCATIONS

(R) IS THE RELEASE SITE

Figure 3.3.18

extend to about 7000 ft on this day, again indicating transport aloft. It was not possible to verify the wind convergence or the resulting transport of the tracer but a similar set of conditons led to the transport aloft of a tracer released from Los Banos during the July test program (Volume 4, Test 6).

Detection of tracer on day following release

While a majority of the tracer released was unaccounted for, a small portion was detected on the day following the release near the center of the southern San Joaquin Valley. During Traverse 2-2, a maximum concentration of about 67 PPT was detected just north of Buttonwillow at about 0830 PDT. The tracer detected at this location may have been that initially transported towards Buttonwillow or perhaps some part of the tracer initially transported to the west. In either event, the amount of tracer detected was not a significant portion of the tracer originally released.

Summary

During this experiment, the tracer released at Fellows, on the extreme western edge of the San Joaquin Valley, was apparently transported towards the west and the valley edge. Only a very small amount of SF6 could be accounted for within the valley during the test. The tracer was apparently carried aloft and rapidly dispersed in the upper artmosphere. This behavior is very similar to that observed during a previous release from a location on the western edge of the San Joaquin Valley (Los Banos, Test 6, July intensive period). This suggests that the convergence of onshore winds from the coast and the easterly upslope flow often observed on the western side of the San Joaquin Valley may lead to transport aloft during typical afternoon atmospheric conditions. This would cause pollutants to be mixed over a larger volume (leading to lower concentrations) than would be the case for pollutants trapped within the surface layer of the atmosphere. Transport aloft, however, would presumably facilitate long range (horizontal) transport of pollutants and perhaps lead to significant impact on areas downwind of the San Joaquin Valley.

3.4 Test 4 14-15 September 1979, Fellows Release (0147-0647 PDT)

3.4.1 Meteorology

General

The synoptic meteorology of the test period was characterized by an intense ridge aloft at 500 mb along the west coast of Canada and the U.S (Figure 3.4.1). The ridge had been building over the previous 48 hours coincident with a deepening trough in the eastern Pacific. As reflected in the 850 mb measurements from Oakland and Vandenberg on Figure 2.2.1, temperatues aloft continued warm and well above normal. At the surface, a large high pressure area covered all but the east coast of the U.S. A minor ridge was located just off the central California coast and pressure gradients favored an onshore flow. The sky was generally clear throughout the San Joaquin Valley. Visibility ranged from 15-25 miles at Stockton, and 10-15 miles at Fresno and Bakersfield. Maximum reported temperatures at Fresno and Bakersfield were 102°F and 105°F, respectively; or about 10° above normal for September.

Transport Winds

Surface winds at the release site have been tabulated in Table 3.4.1. During the release, a drainage flow persisted, predominately from the southwest. Wind speeds under the drainage conditions ranged from 2-4 m/s. During the last hour of the release, the winds shifted to the northwest and decreased in intensity. Winds continued light and variable during the forenoon hours becoming north to northwest during the afternoon. Wind speeds during the northwest flow ranged from 2-5 m/s. As can be seen from Figure 3.4.2 the time cross section of the pibal winds at Taft, the drainage flow was in a shallow layer about 100 m thick which was undercutting a regime of northerly flow. Afternoon flows aloft generally had a strong northerly component but varied from the east to west quadrants. By the 2100 PDT observation, a westerly flow in the lower layers was re-established.

FRIDAY, SEPTEMBER 14, 1979

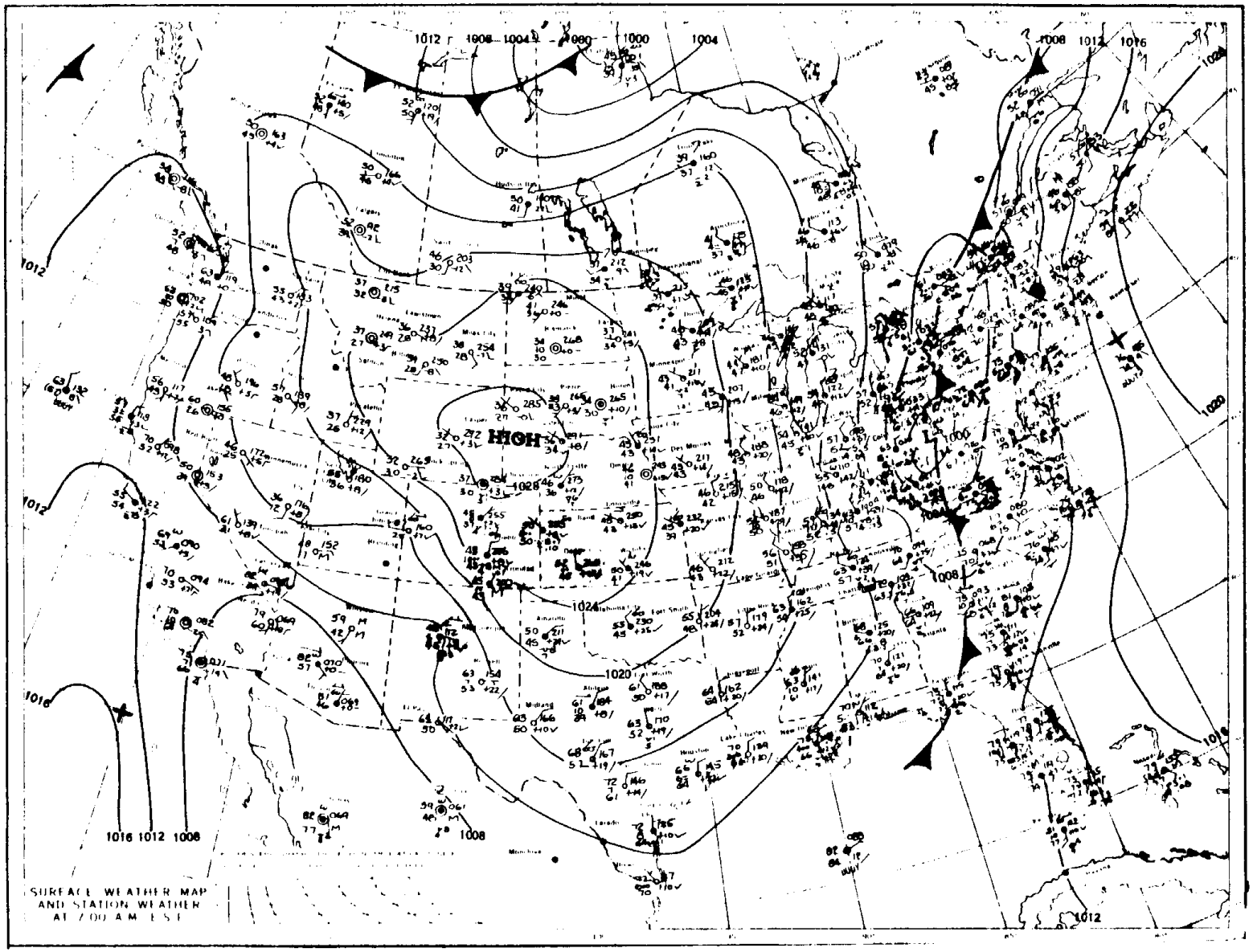


Figure 3.4.1 Surface Weather Chart - 14 September 1979 (05 PDT)

Table 3.4.1

SURFACE WINDS FROM FELLOWS
14 SEPTEMBER 1979

Time (PDT)	Wind Direction/Speed (m/s)
02	250/3.6
03	240/3.6
04	225/3.5
05	220/3.1
06	220/2.2
07	315/1.3
08	310/0.9
09	075/0.9
10	060/1.8
11	180/0.9
12	115/2.9
13	335/4.9

The shallow drainage flow during the tracer release necessitates describing the initial horizontal transport with streamlines constructed from the winds measured in the surface to the 100 m layer (Figure 3.4.3). Transport from the tracer release site within this layer was directed to the east toward a convergence zone in the center of the valley. Material injected above the drainage flow was subjected to a different flow regime which is described by the streamlines constructed from the 1000 ft-agl winds and shown in Figure 3.4.4. Transport from the release site under these conditions would be to the southeast into the southern portion of the valley where the flow then eddies and returns north on the east side. The regional transport after drainage flows have ceased is described by the streamlines depicted on Figure 3.4.5. The eddy in the southern half of the valley has developed to its maximum such that on the eastern flank

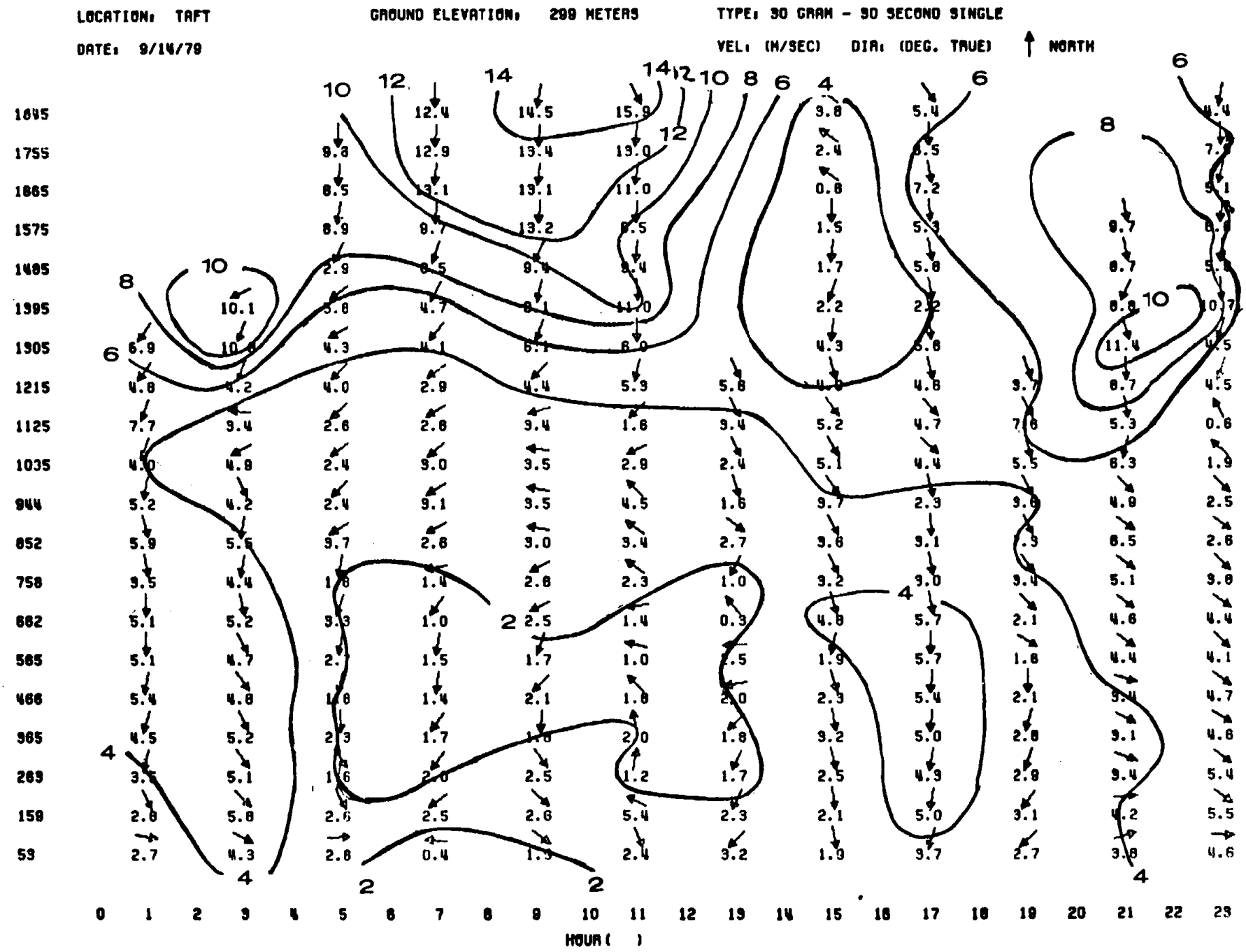


Figure 3.4.2 Time-Height Cross Section From Taft - 14 September 1979

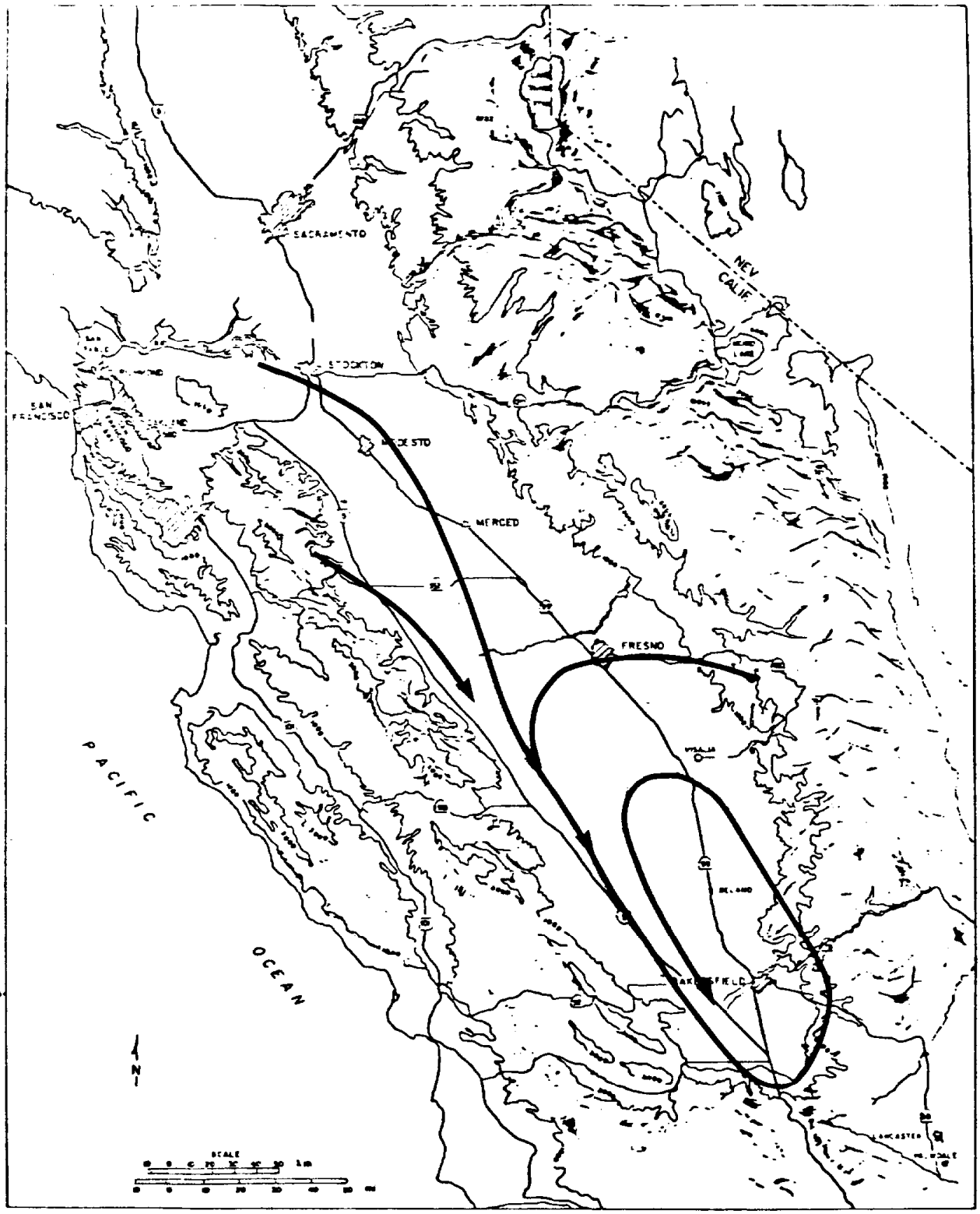


Figure 3.4.3 1000 Ft-agl Streamlines - 14 September 1979 (05 PDT)

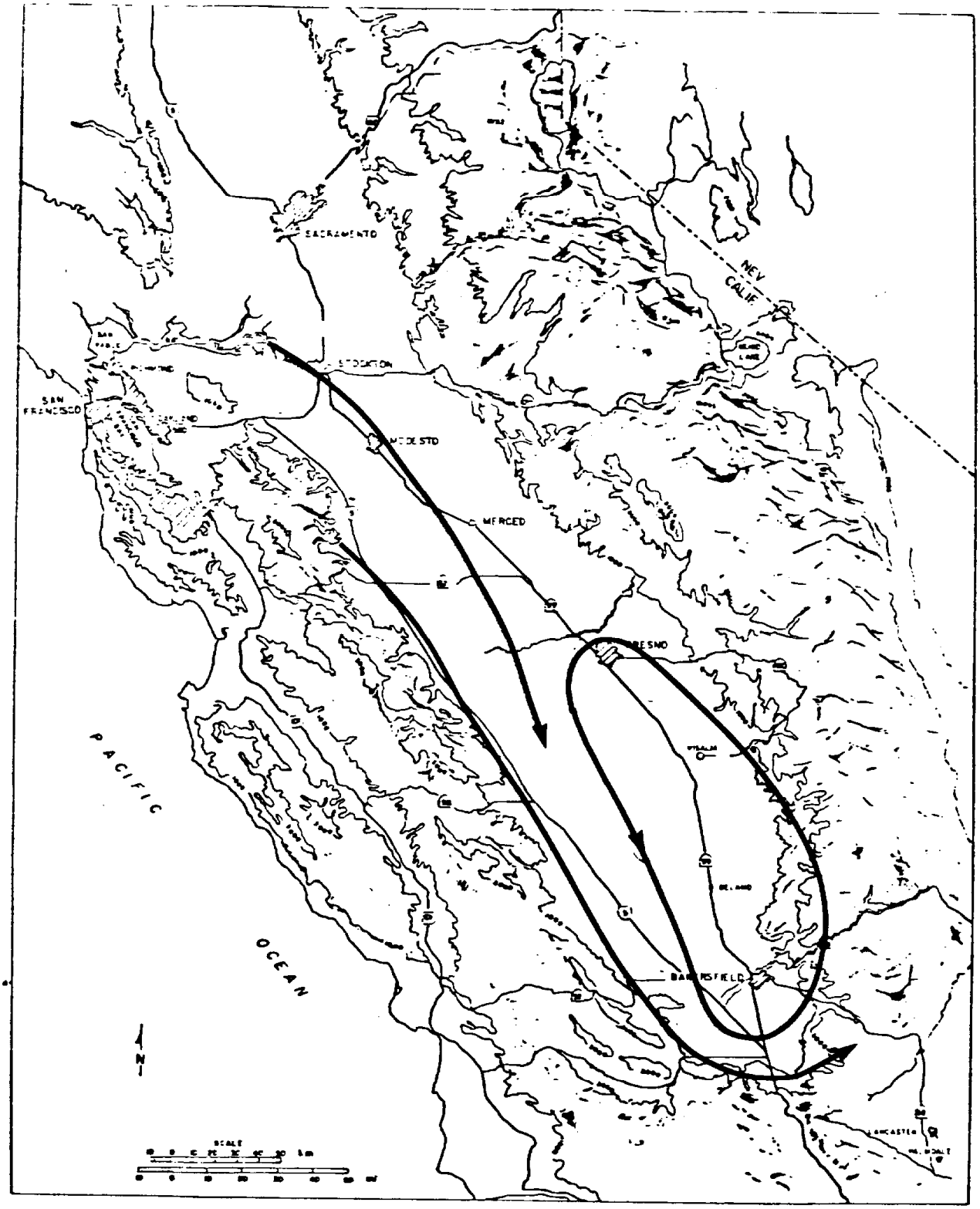


Figure 3.4.4 1000 Ft-agl Streamlines - 14 September 1979 (09 PDT)

the flow returns north past Fresno. The winds from Bakersfield west, however, continued from the northwest at 2-3 m/s. As shown from the streamlines on Figure 3.4.5, the eddy persisted in the Fresno-Visalia area until 1500 PDT that afternoon. The continuing northwest flow on the west side of the valley diverges into the adjacent mountains at the southern end. By 19 PDT (Figure 3.4.6) the eddy had been replaced by northwest flow throughout the valley. Drainage flow was re-established by 1900 PDT at Fellows and 2100 PDT at Oildale.

Mixing Heights

Aircraft determinations of the mixing height in the valley on the 14th ranged to about 1300 m and are shown in Table 3.4.2. On the following day, mixing heights in the southern part of the valley remained relatively low (200-600 m) until mid-morning.

Table 3.4.2

AIRCRAFT MIXING HEIGHTS

Time (PDT)	Location *	Mixing Height (m [above ground level])
	September 14, 1979	
1436	4 NW Bakersfield	1050
1547	Caliente	1285
1749	4 NW Bakersfield	840
	September 15, 1979	
0748	4 NW Bakersfield	330
0838	Caliente	260
0858	27 SSE Bakersfield	690
0932	Taft	400 (785)
1019	Wasco	200 (920)

* Distances in miles

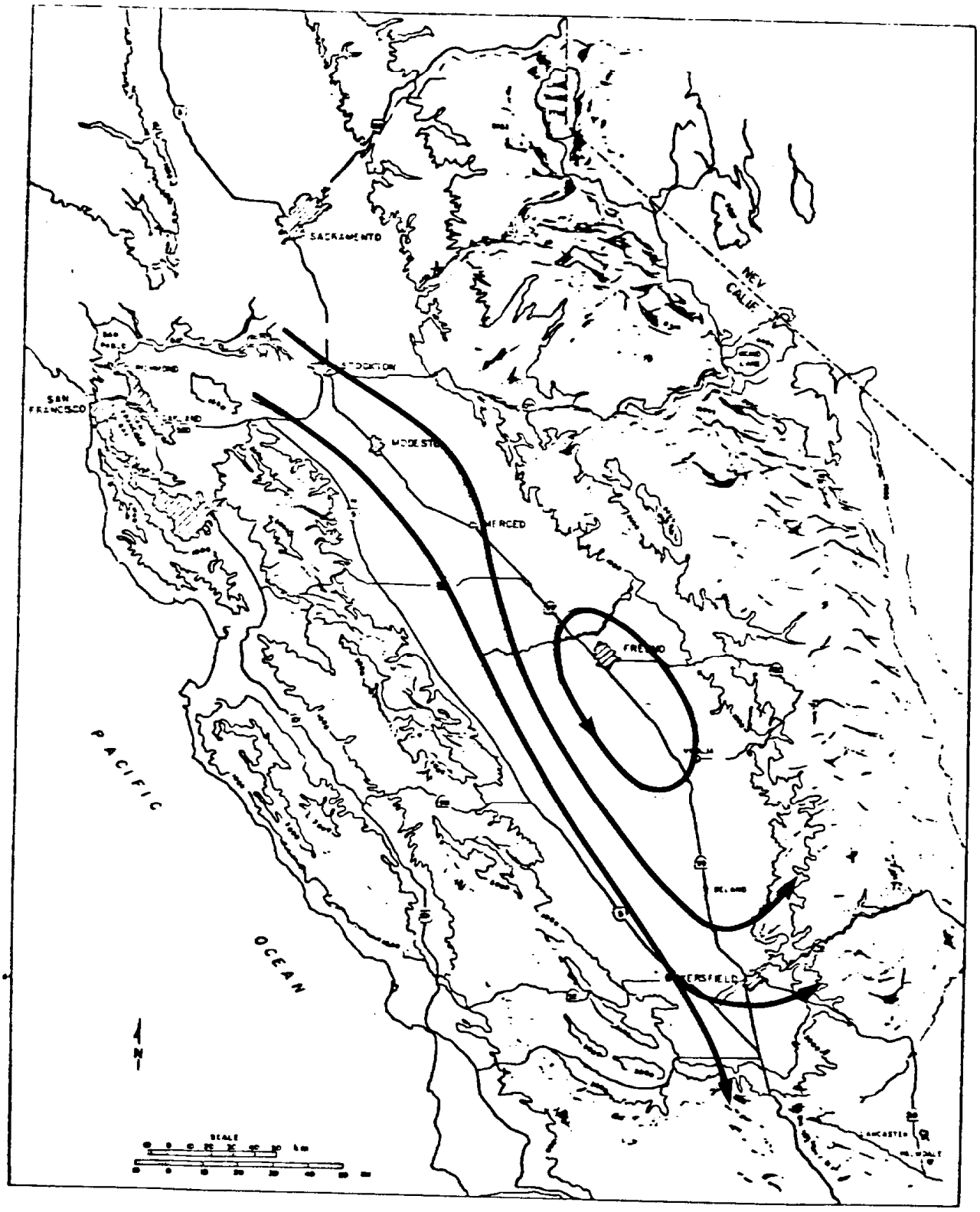


Figure 3.4.5 1000 Ft-agl Streamlines - 14 September 1979 (15 PDT)

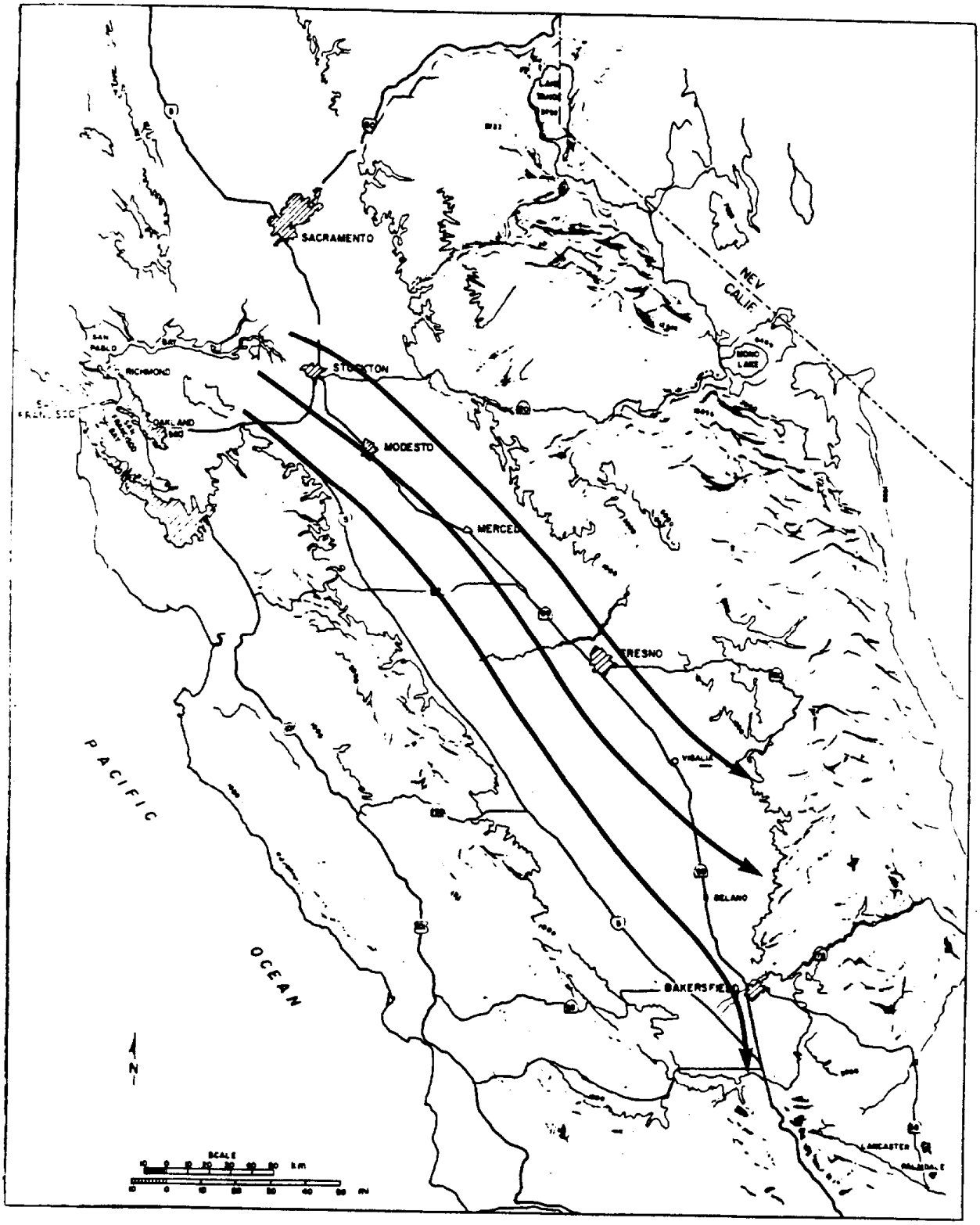


Figure 3.4.6 1000 Ft-agl Streamlines - 14 September 1979 (19 PDT)

3.4.2 Air Quality

Regional Pollutant Levels

Maximum hourly average ozone concentrations for 14 September are shown on Figure 3.4.7. Within the San Joaquin Valley, exceedances of California's air quality standard were experienced in the Fresno and Hanford-Visalia areas. The oxidant standard was also exceeded at Shaver Lake, in the Sierra Nevada east of Fresno, and at Miracle Hot Springs, east of Bakersfield also in the Sierra Nevada Range. Highest recorded hourly value was .14 ppm at Hanford.

Table 3.4.3 gives the maximum hourly concentrations of SO_2 and NO_x observed at any station in the valley on September 14. Also shown are the highest hourly observations recorded at the Rockwell International vans. Concentrations of all pollutants were similar to those observed on September 11 (Table 3.3.3) as the warm temperatures aloft continued to prevail over the valley.

Table 3.4.3

MAXIMUM HOURLY CONCENTRATIONS
SEPTEMBER 14, 1979

Parameter	Location	Maximum Value (ppm)
SO_2	Bakersfield	.05
CO	Bakersfield	2
NO_x	Bakersfield	.36
SO_2	Arvin (RI)	.01
SO_2	Lost Hills (RI)	.01
NO_x	Arvin (RI)	.02
NO_x	Lost Hills (RI)	.04
NO	Reedley (RI)	.03

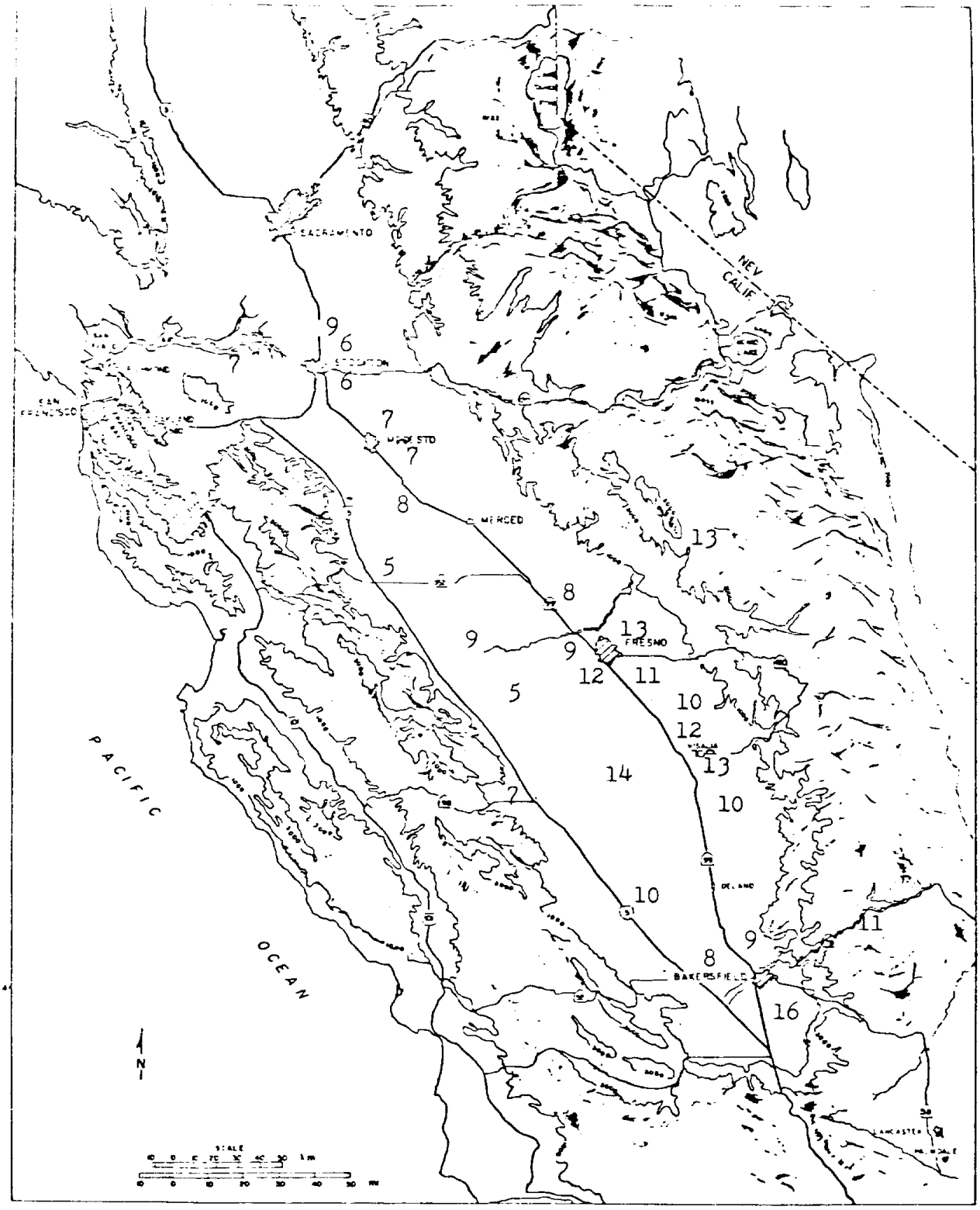


Figure 3.4.7 Maximum Hourly Ozone Concentrations (pphm) - 14 September 1979

Aircraft Sampling

In conjunction with an early morning tracer release from Fellows, aircraft sampling missions were flown on the afternoon (1434-1815 PDT) of the release and again on the following morning (0746-1056 PDT). The afternoon sampling consisted of a series of traverses within the mixing layer providing widespread coverage in the southern San Joaquin Valley and into Tehachapi Pass. Spirals were flown near Bakersfield, Caliente, and Tehachapi. Spirals over the Bakersfield VOR at the start and end of sampling documented the temporal changes during sampling. On the following morning the sampling consisted of a series of spirals and traverses within the southern region of the valley to primarily measure the carry-over and distribution of tracer material.

The sampling route followed during the afternoon of September 14 is shown in Figure 3.4.8. Table 3.4.4 gives a summary of the pollutant characteristics measured during the flight. Figures 3.4.9 to 3.4.11 show soundings made during the afternoon flight.

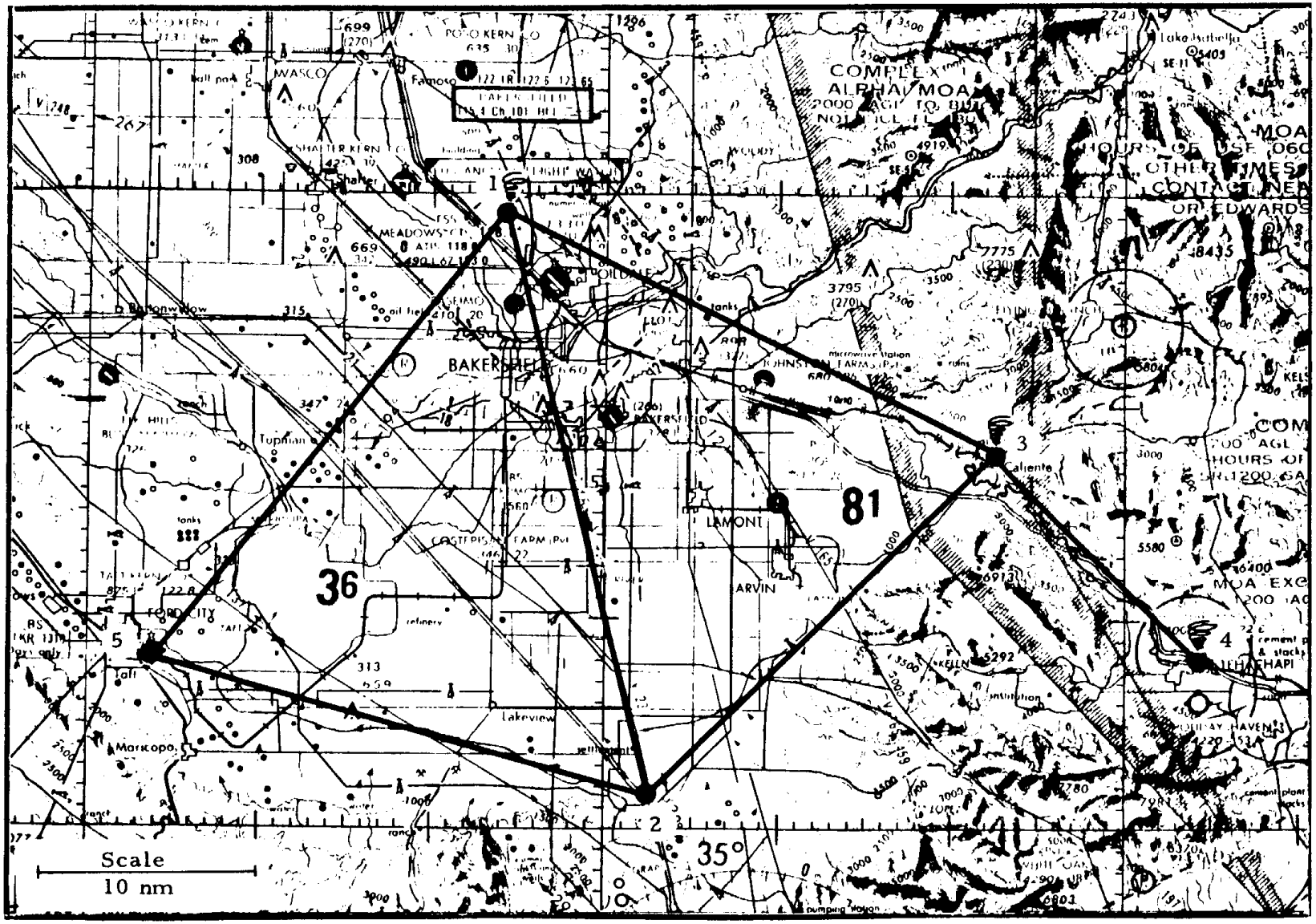
The morning sampling route on September 15 is given in Figure 3.4.12. A summary of the pollutant characteristics for the morning flight is shown in Table 3.4.5. The aircraft soundings made during the flight appear in Figures 3.4.13 to 3.4.17.

Figure 3.4.9 shows the aircraft sounding made near Bakersfield at 1436 PDT on September 14. The mixing layer extended to 1200 m (msl) with ozone values relatively constant at .11 to .12 ppm. The sounding suggests a relatively well-mixed layer throughout the lowest 1000 m above ground.

Figure 3.4.10 was made at Caliente at 1547 PDT. The mixed layer was similar in depth (above ground) to that observed earlier at Bakersfield. Ozone levels, however, were near constant to 1560 m (msl) but were much higher at Caliente with peak levels of .23 ppm.

The final sounding of the afternoon was made near Bakersfield at 1744 PDT (Figure 3.4.11). Ozone levels were near constant to 990 m (msl) at about .14 ppm, slightly higher than observed three hours earlier. Top of the mixed layer was at 990 m (msl) with reduced ozone concentrations above that level.

On the following morning (15th) a sounding (Figure 3.4.13) was made at Bakersfield at 0748 PDT. Reduced levels of ozone due to depletion were observed in the lowest layers (to 480 m msl). From there to 1300 m (msl) the



SAMPLING ROUTES 14 SEPTEMBER 1979

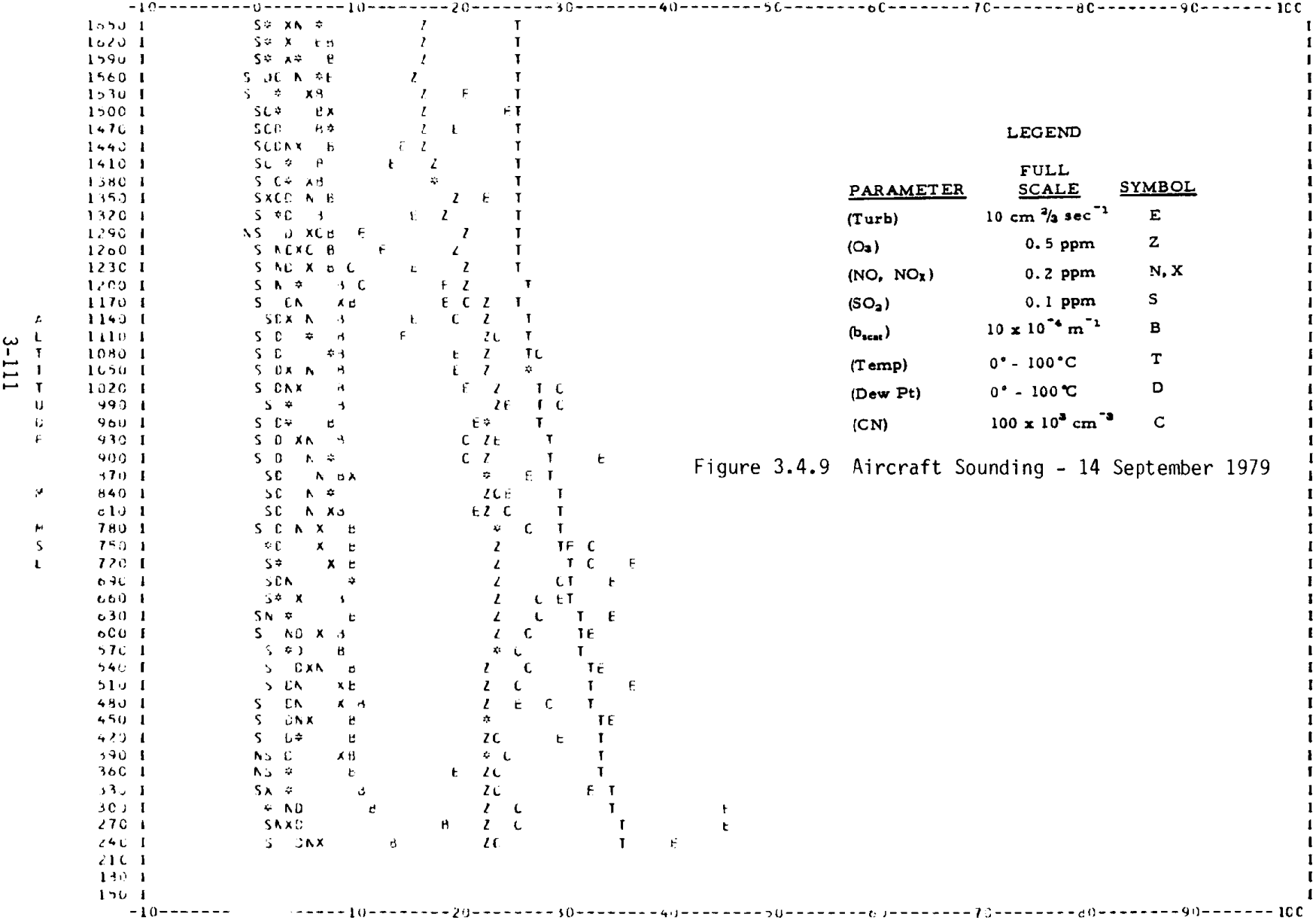
Figure 3.4.8

Table 3.4.4

AIR QUALITY MEASUREMENTS CARB SAN JOAQUIN VALLEY PROJECT
SEPTEMBER 14, 1979 SAMPLING

Start Time (PDT)	Location (Point)	O_3		b_{scat}		SO_2		NO_x		NO	
		Mean (ppb)	Max (ppb)	Mean ($\times 10^{-6} m^{-1}$)	Max	Mean (ppb)	Max (ppb)	Mean (ppb)	Max (ppb)	Mean (ppb)	Max (ppb)
1436	1	96	120	75	232	0	1	9	25	6	22
1513	1-2	130	156	108	222	2	25	12	41	4	17
1533	2-3	180	235	182	304	5	12	18	36	4	15
1547	3	166	234	187	234	8	22	22	87	4	29
1609	4	116	154	100	184	0	2	7	17	3	11
1621	4-3	191	239	230	384	9	18	24	40	3	12
1634	3-1	136	197	125	296	7	227	18	31	4	12
1654	1-5	123	133	97	160	1	4	10	25	3	11
1710	5-2	131	152	107	192	1	1	11	23	4	13
1729	2-1	137	169	117	196	3	39	18	85	4	21
1749	1	108	138	87	216	1	3	10	22	3	14

DATE: 9/14/79 ROUTE: OVER POINT 1 (CONTINUED)
CARTRIDGE/PASS: 7087 1
TIME: 14:36:46 TO 14:51:18 MIN. GROUND ELEV.: 152 M(MSL)

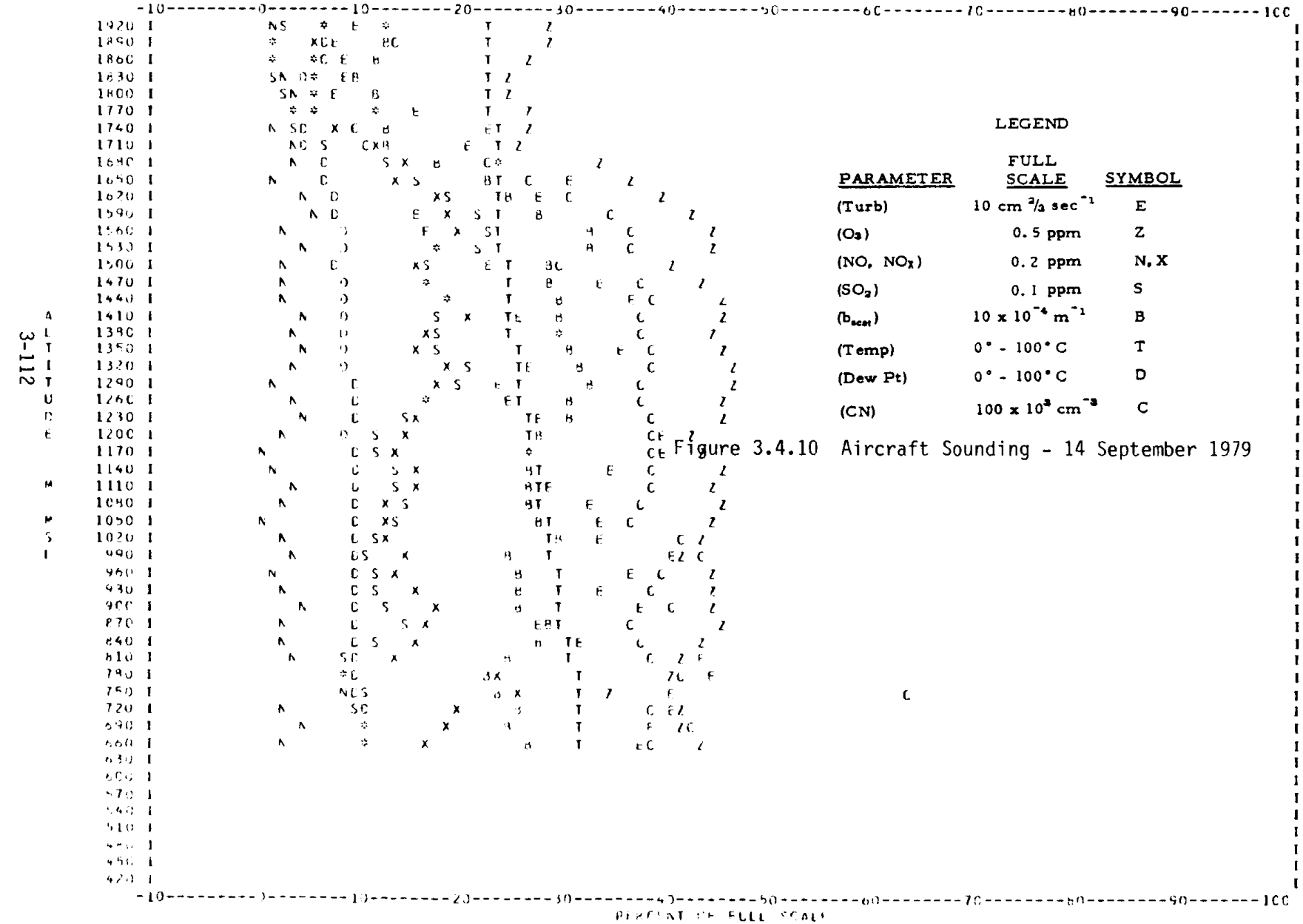


LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec $^{-1}$	E
(O_3)	0.5 ppm	Z
(NO, NO_x)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100°C	T
(Dew Pt)	0° - 100°C	D
(CN)	100 x 10^3 cm^{-3}	C

Figure 3.4.9 Aircraft Sounding - 14 September 1979

DATE: 9/14/79 ROUTE: [illegible] POINT 3
CAMPAIGN/PASS: 7CB/ 5
TIME: 15:47:17 TO 16: 1:42 MIN. GROUND ELEV.: 426 M(MSL)



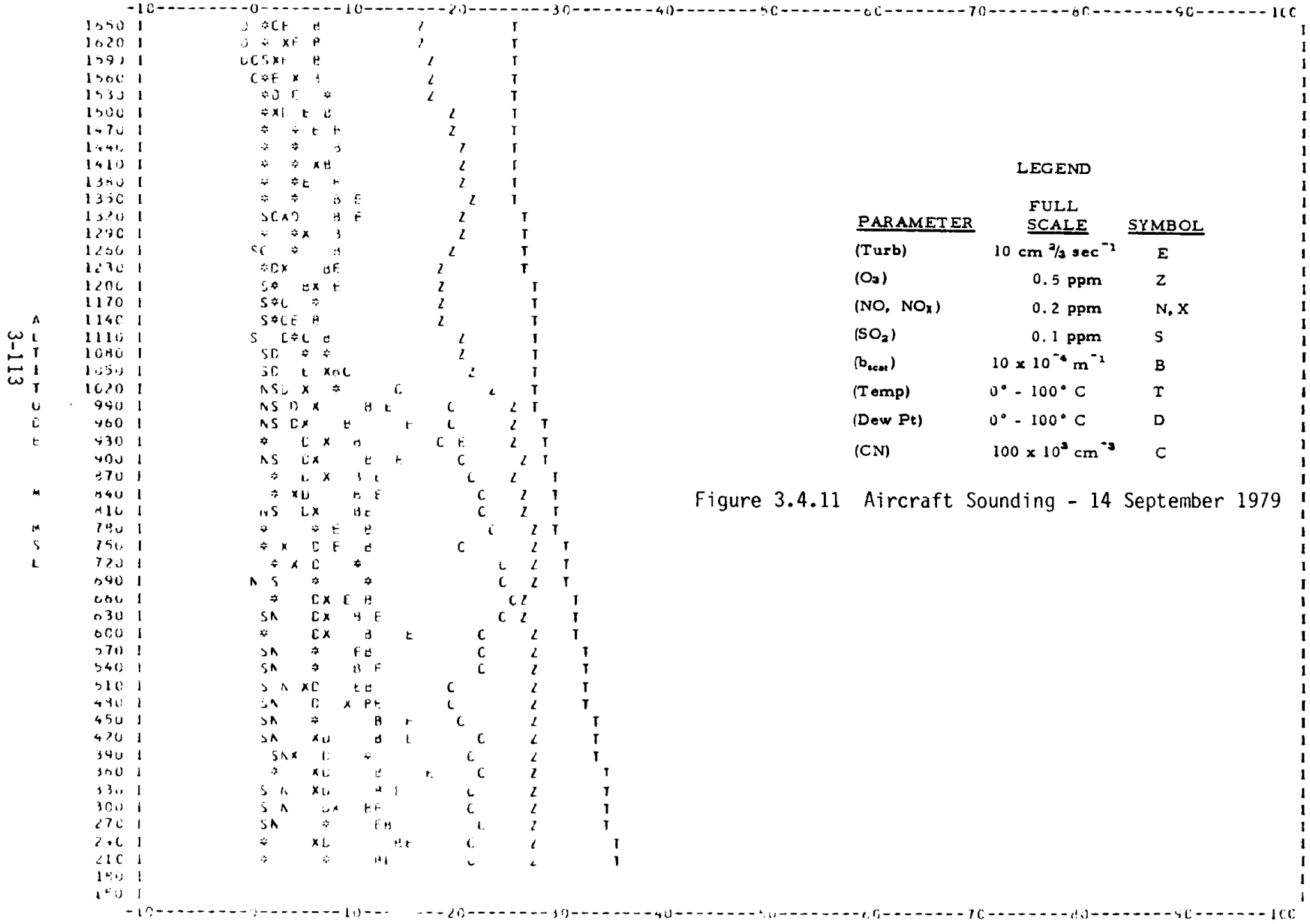
LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec $^{-1}$	E
(O_3)	0.5 ppm	Z
(NO, NO_X)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100° C	T
(Dew Pt)	0° - 100° C	D
(CN)	100 x 10^3 cm^{-3}	C

Figure 3.4.10 Aircraft Sounding - 14 September 1979

DATE: 9/14/79
CARTRIDGE/PASS: 7CR/ 12
TIME: 17:49:16 TO 18: 2:23

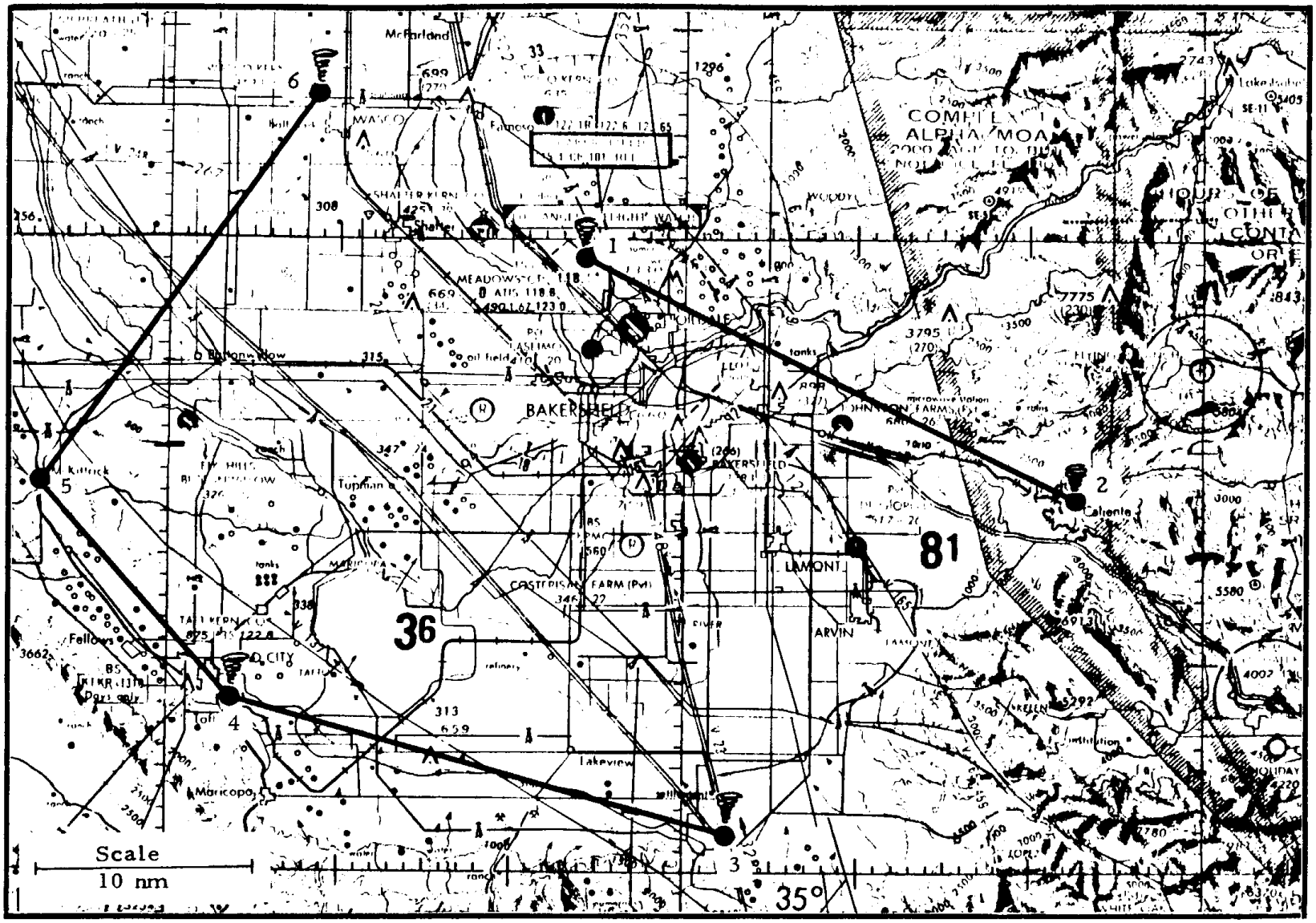
ROUTE: OVER POINT 1
MIN. GROUND ELEV.: 152 M(MSL)



LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec^{-1}	E
(O_3)	0.5 ppm	Z
(NO, NO_X)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100° C	T
(Dew Pt)	0° - 100° C	D
(CN)	100 x 10^{3} cm^{-3}	C

Figure 3.4.11 Aircraft Sounding - 14 September 1979



SAMPLING ROUTES 15 SEPTEMBER 1979

Figure 3.4.12

Table 3.4.5

AIR QUALITY MEASUREMENTS CARB SAN JOAQUIN VALLEY PROJECT
SEPTEMBER 15, 1979 SAMPLING

Start Time (PDT)	Location (Point)	O_3		b_{scat}		SO_2		NO_x		NO	
		Mean (ppb)	Max (ppb)	Mean ($x10^{-6}m^{-1}$)	Max	Mean (ppb)	Max (ppb)	Mean (ppb)	Max (ppb)	Mean (ppb)	Max (ppb)
0748	1	87	146	72	168	2	5	4	14	-1	2
0821	1-2	91	130	80	142	1	2	9	33	4	14
0839	2	62	101	50	116	0	2	10	53	6	20
0858	3	76	113	56	110	0	1	5	13	3	11
0915	3-4	113	142	88	166	3	10	8	18	3	13
0932	4	102	142	84	176	5	8	13	73	6	22
0953	4-5	120	137	104	160	9	21	19	41	4	14
1004	5-6	123	134	104	188	3	25	12	45	3	12
1020	6	100	145	81	204	1	9	11	41	5	14
1040	1	102	166	79	172	2	28	11	63	4	18

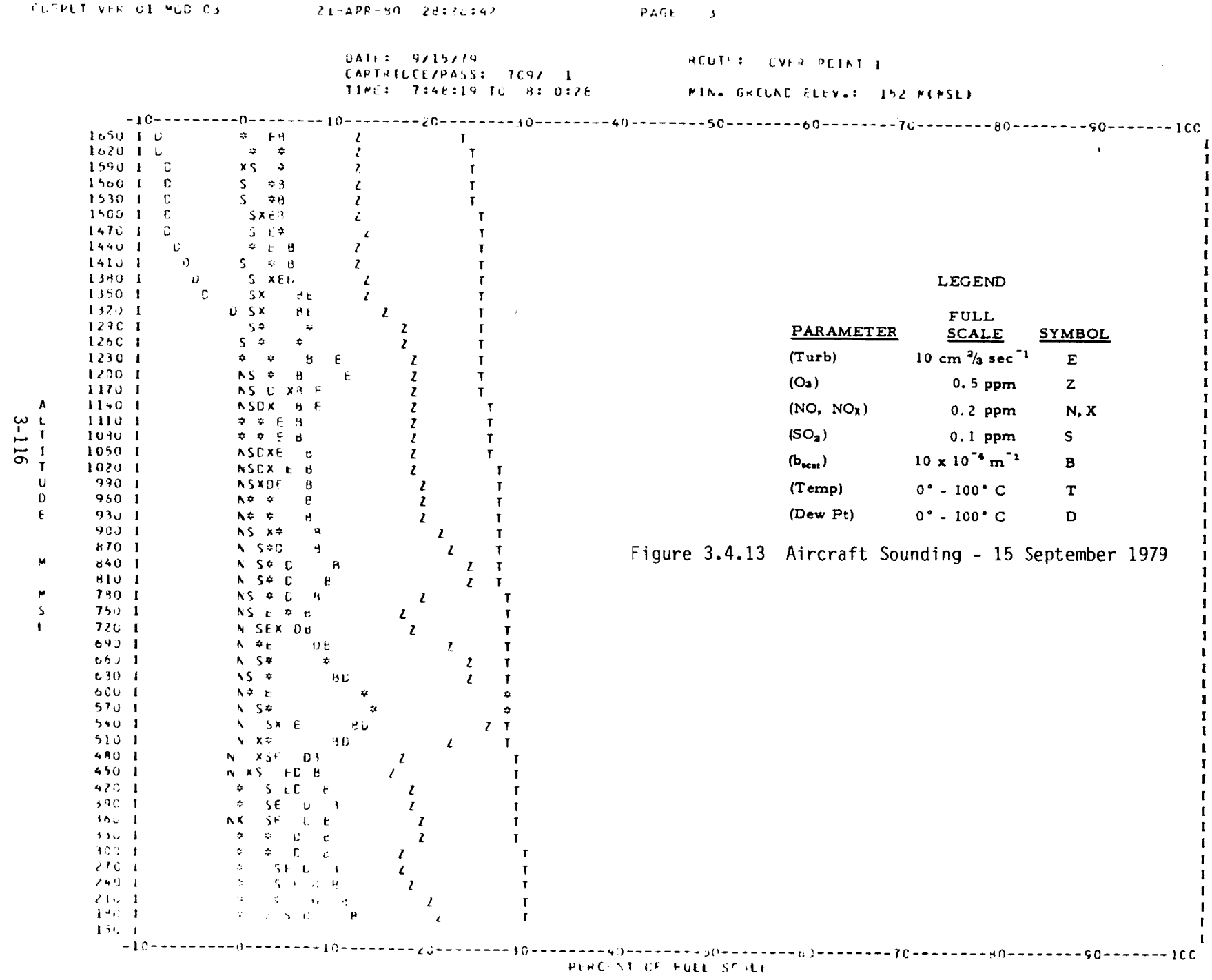
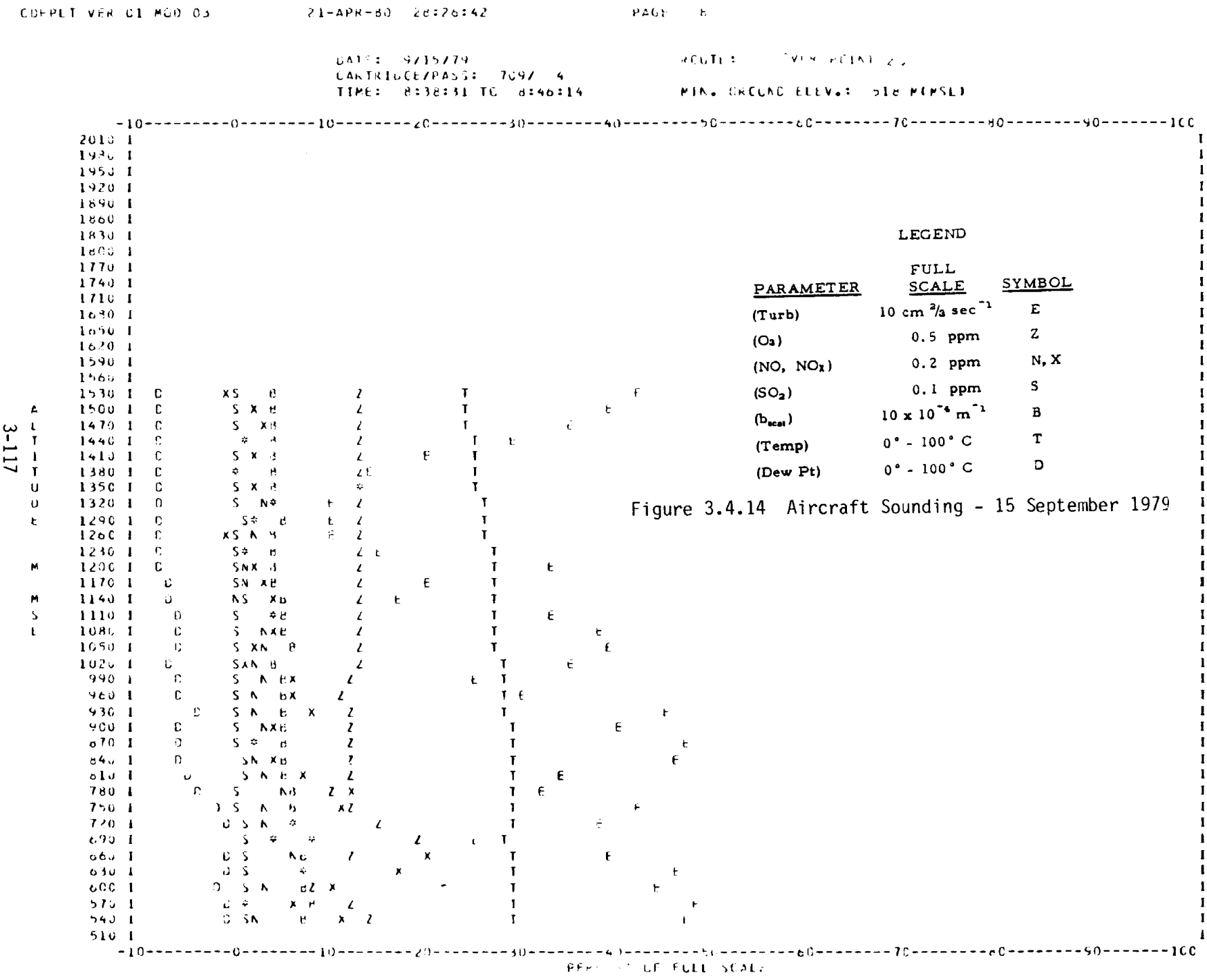


Figure 3.4.13 Aircraft Sounding - 15 September 1979



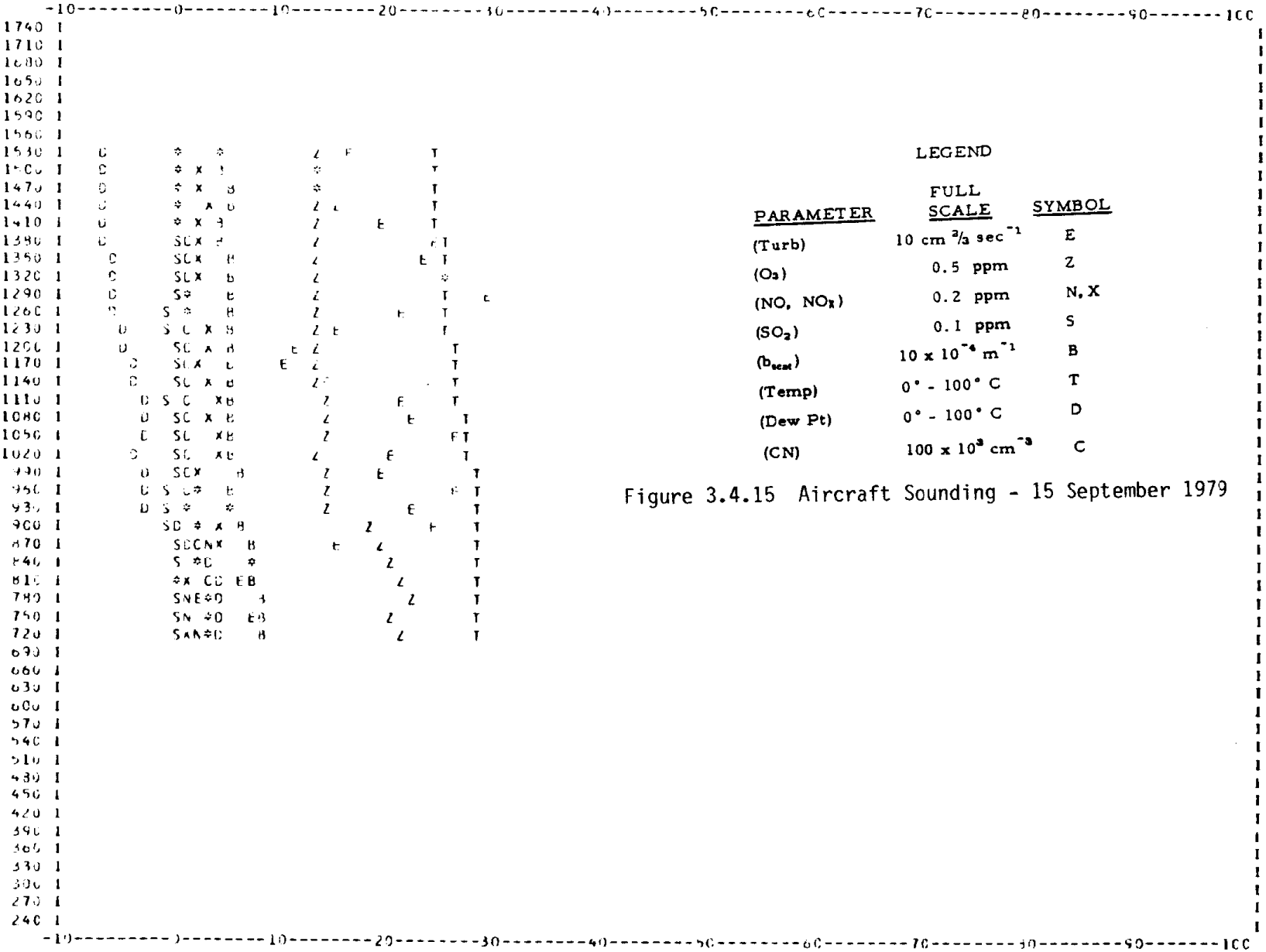
LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec^{-1}	E
(O_3)	0.5 ppm	Z
(NO, NO_x)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100° C	T
(Dew Pt)	0° - 100° C	D

Figure 3.4.14 Aircraft Sounding - 15 September 1979

DATE: 9/15/79
CARTRIDGE/PASS: 7097 5
TIME: 8:58:18 TO 9: 4:48

MELTS: [illegible]
MIN. GROUND ELEV.: 243 M(MSL)



LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec $^{-1}$	E
(O_3)	0.5 ppm	Z
(NO, NO_x)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100° C	T
(Dew Pt)	0° - 100° C	D
(CN)	100 x 10^3 cm^{-3}	C

Figure 3.4.15 Aircraft Sounding - 15 September 1979

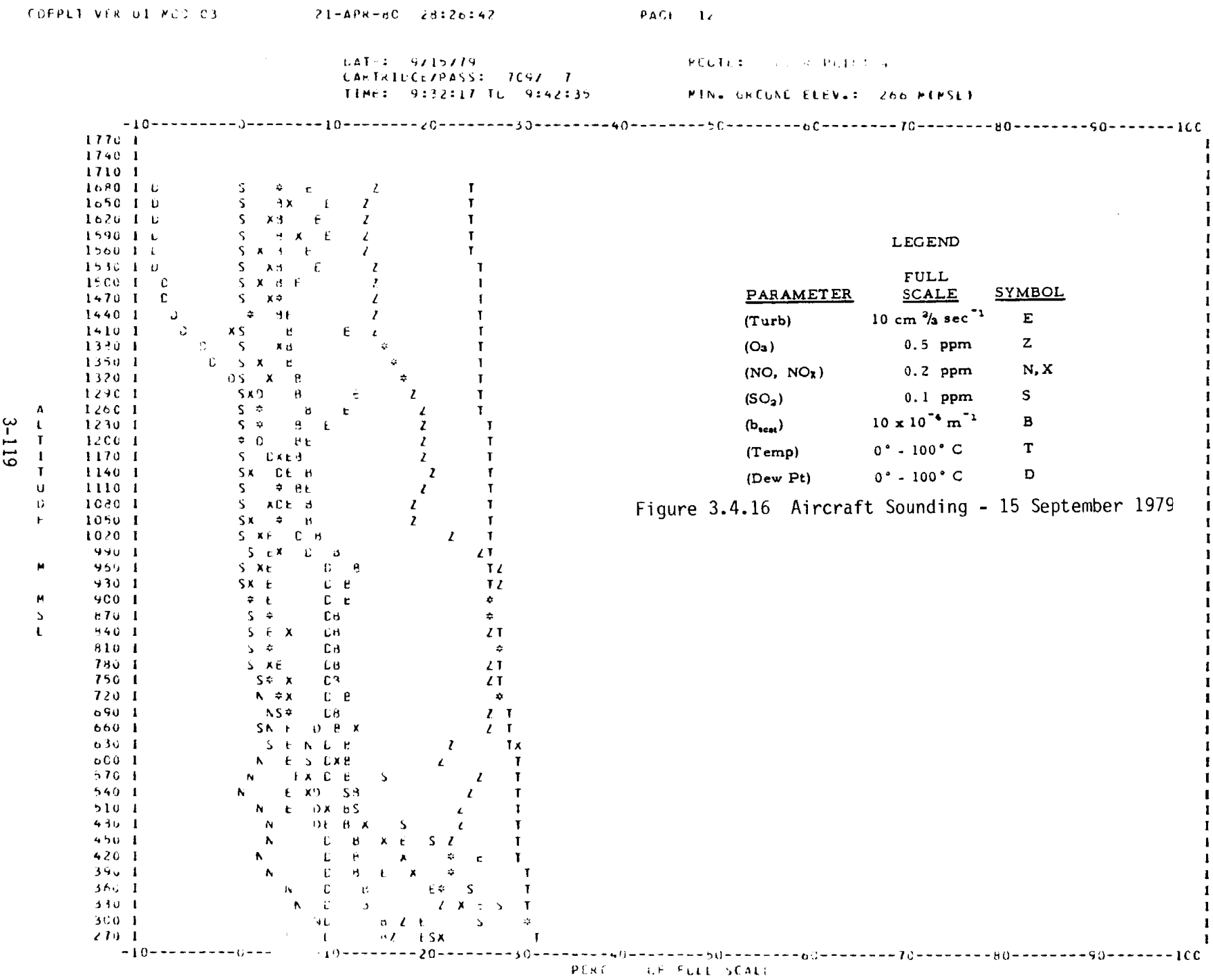


Figure 3.4.16 Aircraft Sounding - 15 September 1979

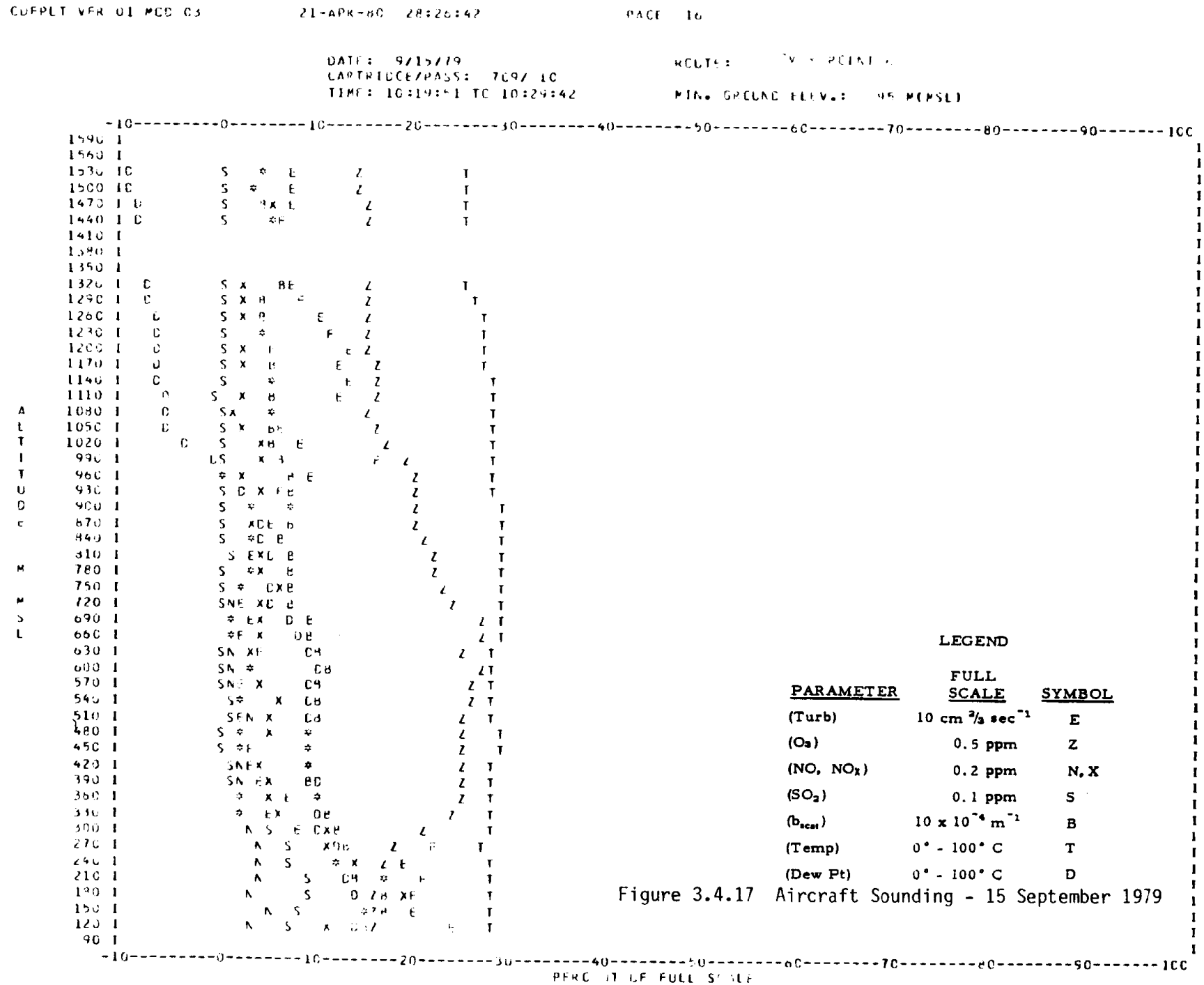


Figure 3.4.17 Aircraft Sounding - 15 September 1979

ozone concentrations were similar to those observed the previous night. At levels higher than 1300 m (msl) evidence of a dry, clean layer appeared which was not present the night before. Winds during the night were southwest to south with low velocities in the layer between 480 and 1300 m where the ozone levels remained relatively constant through the night. No pronounced SO_2 concentrations were observed in the early morning sounding as had appeared in Test 3.

Figure 3.4.14 was made at Caliente at 0838 PDT. A shallow layer of ozone (lowest 200 m) showed ozone concentrations to .10 ppm. Above that 750 m (msl) a very dry layer was present and ozone concentrations were at background levels. The base of the dry layer at Caliente was much lower than at Bakersfield one hour earlier. The dry layer was associated with southeast winds bringing desert air into the area aloft.

Figure 3.4.15 was the sounding made in the southern part of the valley at 0858 PDT. The base of the dry layer was at 930 m, intermediate between Caliente and Bakersfield. Ozone concentrations were at background levels in the dry air and showed relatively small amounts (.11 ppm) below that layer.

A sounding was made at Maricopa (Figure 3.4.16) at 0932 PDT. Ozone concentrations to .13 ppm were observed below the dry layer. The base of the dry layer was at about 1400 m (msl), about the same as at Bakersfield two hours earlier. Relatively large concentrations (.02 to .03 ppm) of SO_2 were observed over Maricopa. Ozone and SO_2 levels, in comparison to the Caliente observations, suggest east-west transport of the pollutants which normally accumulate near Caliente.

Figure 3.4.17 was obtained near Wasco at 1014 PDT. The base of the dry layer was at about 1000 m (msl). Ozone concentrations up to .14 ppm were found in the layers below the base of the dry layer. Ozone depletion and increased SO_2 concentrations were apparent in the mixed layer (lowest 200 m). Higher concentrations of ozone were left over from the previous day.

3.4.3 Tracer Test 4

Release Location: Fellows, Kern County
Time and Date: 0107-0647 PDT, 9/14/79
Release Amount: 108 lbs SF6/hr
Release conducted during southwesterly drainage winds.

Initial transport northeast of release site

Throughout most of the release period, the surface winds at Fellows were 2-5 mps from the southwest. Above about 100 m in altitude the winds were from the north. The flow aloft apparently led to the development of a large counter-clockwise eddy motion in the extreme southern end of the San Joaquin Valley. As shown by Traverse 1-1 (Figure 3.4.18), the initial transport direction of the tracer was directly east of the release site. The intersection of Hwy 119 and Elk Hills Rd is about 5 miles east of the release site in Fellows. As might be expected in the stable drainage flow, the tracer plume was quite narrow. No additional traverses investigated the location of the tracer plume until after daybreak, but the tracer was apparently transported east of the release site by the shallow drainage layer. Automobile Traverse 1-3, which began at 1048 PDT, detected SF6 concentrations as high as about 300 PPT near Bakersfield. The data collected during this traverse is shown in Figure 3.4.19. The transit time of about 9 hours for the 30-35 mile distance between Fellows and Bakersfield corresponds to a mean transport speed of about 3.5-4 miles per hour, in reasonable agreement with the surface wind speeds at the release site. Based on surface wind data, drainage flows from slopes on each side of the valley apparently converged near the center of the valley. The tracer would not be expected to be efficiently transported across this mid-valley convergence zone. The detection of the tracer near Bakersfield during the morning after the release suggests, however, that air from the western side of the valley was efficiently transported into the eastern side of the valley.

The observed transport was probably due to the poorly defined structure of the convergence zone near the southern end of the valley. At the southern end of the valley, the drainage winds have westerly, southerly and easterly

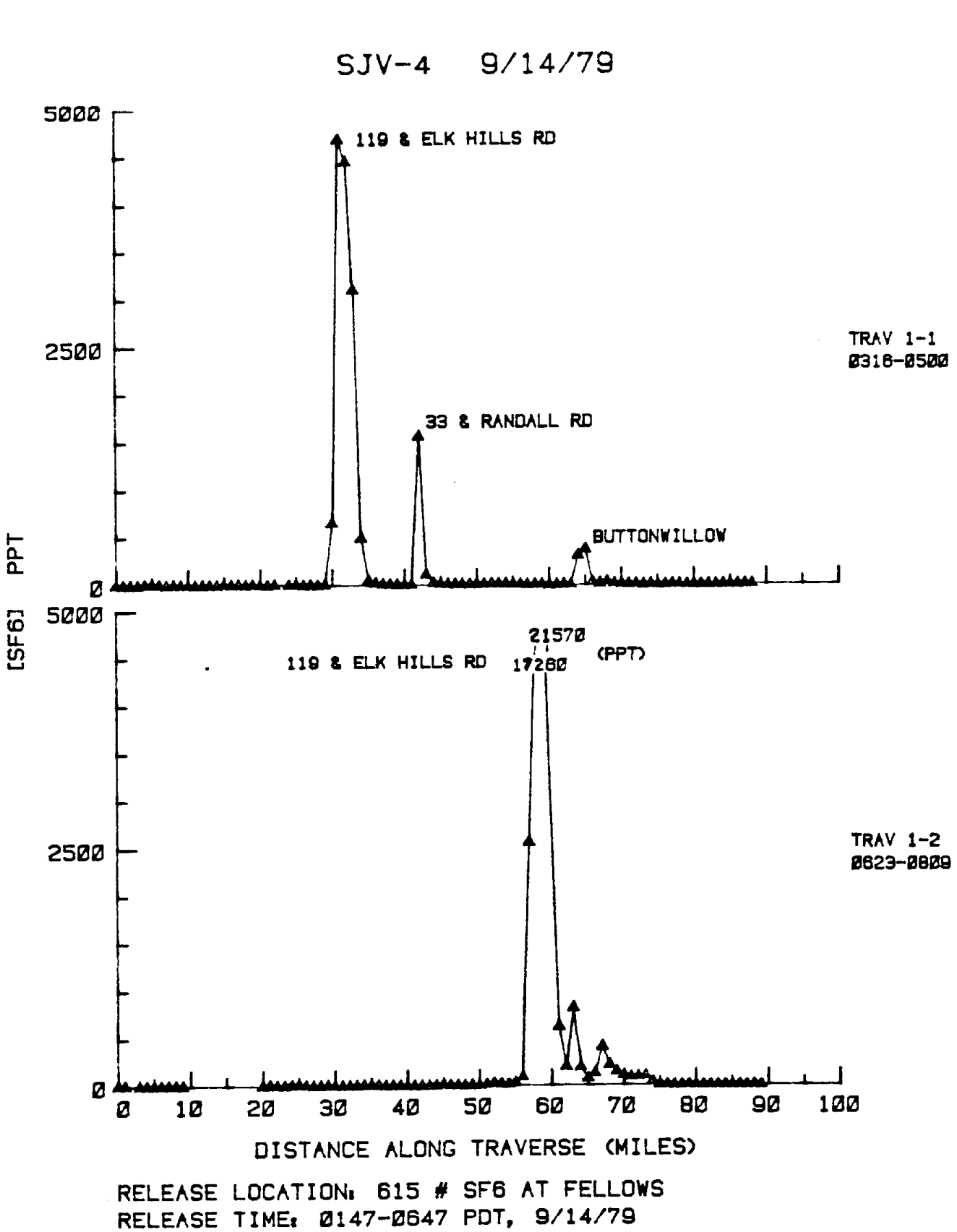

SJV-4 9/14/79
5000
2500
0
119 & ELK HILLS RD
33 & RANDALL RD
BUTTONWILLOW
TRAV 1-1
0316-0500
[SF6] PPT
5000
2500
0
21570
119 & ELK HILLS RD 17280 (PPT)
TRAV 1-2
0623-0809
0 10 20 30 40 50 60 70 80 90 100
DISTANCE ALONG TRAVERSE (MILES)
RELEASE LOCATION: 615 # SF6 AT FELLOWS
RELEASE TIME: 0147-0647 PDT, 9/14/79

Figure 3.4.18

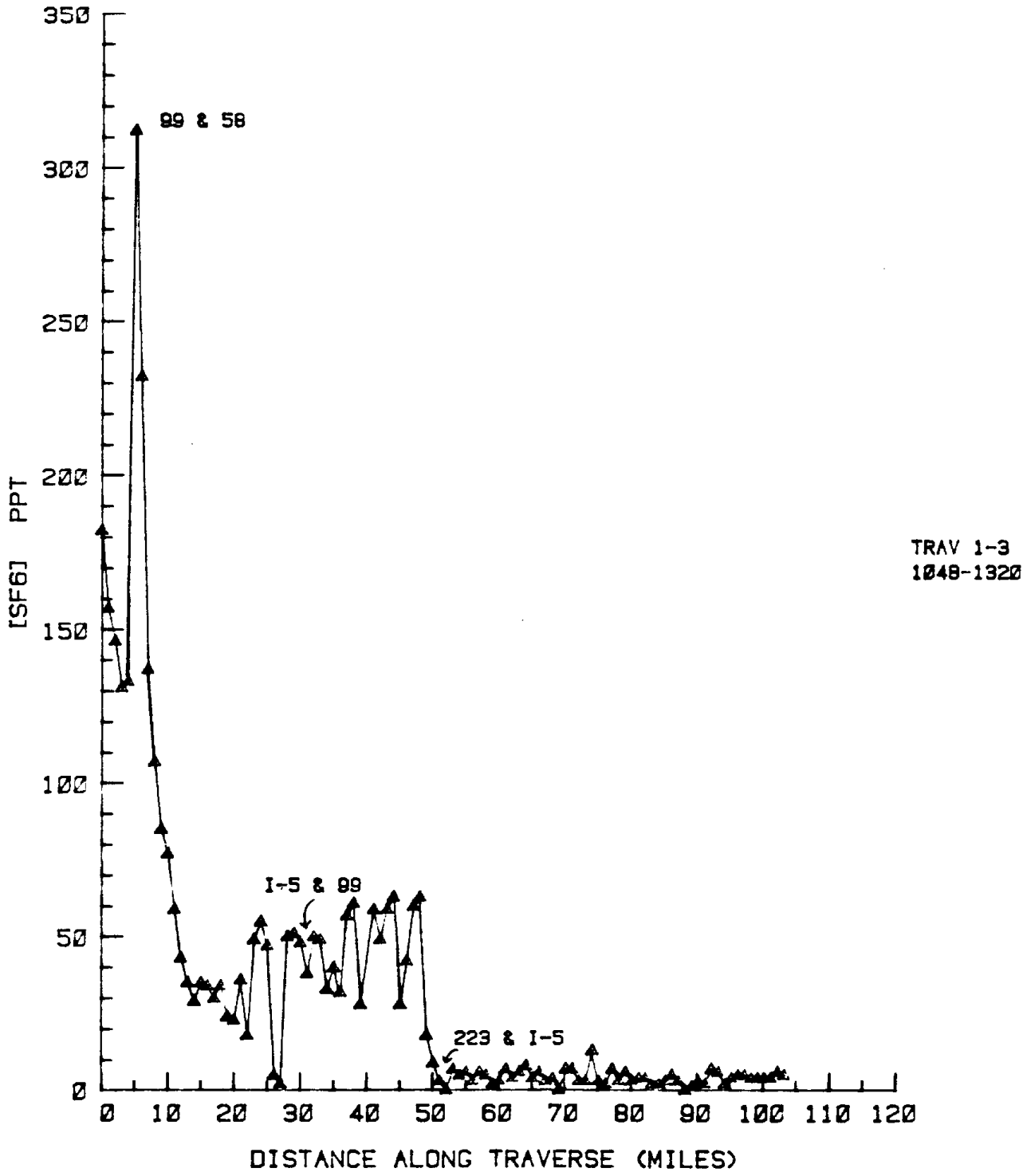

SJV-4 9/14/79
350
300
250
200
150
100
50
0
[SF6] PPT
99 & 58
I-5 & 99
223 & I-5
TRAV 1-3
1048-1320
0 10 20 30 40 50 60 70 80 90 100 110 120
DISTANCE ALONG TRAVERSE (MILES)
RELEASE LOCATION: 615 # SF6 AT FELLOWS
RELEASE TIME: 0147-0647 PDT, 9/14/79

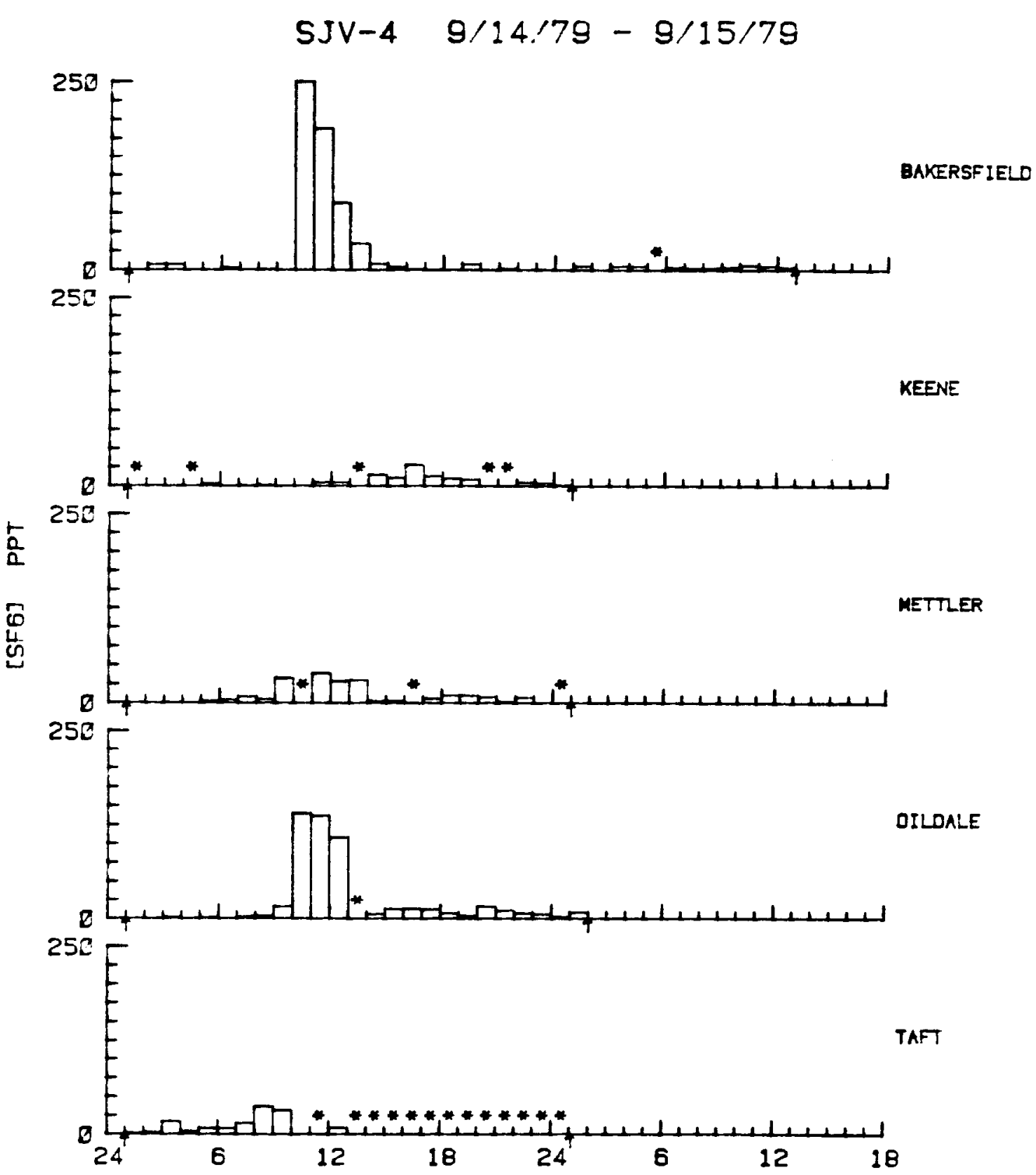
Figure 3.4.19

components due to the surrounding mountain slopes. Cross-valley transport may have been accentuated on this particular day because of the apparent formation of a counter-clockwise eddy at the extreme southern end of the valley. The formation of some sort of eddy at the juncture of the predominant northerly mid-valley winds and the southerly drainage winds, however, is probably quite common, suggesting that cross-valley transport is also quite common. A number of previously conducted tracer experiments also indicated the potential for cross-valley transport during a variety of meteorological conditions.

Cross-valley transport was also indicated during this experiment by the detection of SF6 by hourly-averaged samplers at Bakersfield, Oildale and Mettler (see Figure 3.4.20). An average SF6 concentration of 33 PPT (44 PPT/lb-mole SF6 released/hr) was detected at Mettler between 0900 and 1400 PDT. At Bakersfield and Oildale an average SF6 concentration of about 135 PPT (180 PPT/lb-mole released/hr) was detected between 1000 and 1400 PDT. A maximum concentration of about 260 PPT (350 PPT/lb-mole released/hr) was detected in Bakersfield between 1000 and 1100 PDT. Figure 3.4.22 shows grab sample tracer concentrations observed at the Kern County Airport on the edge of Oildale. Note the asymmetry of the concentration profile, the quick rise to a peak followed by a slow decrease with an essentially constant decay rate. This can be compared to the symmetric concentration distribution predicted by the Gaussian plume model.

Transport during afternoon on day of release

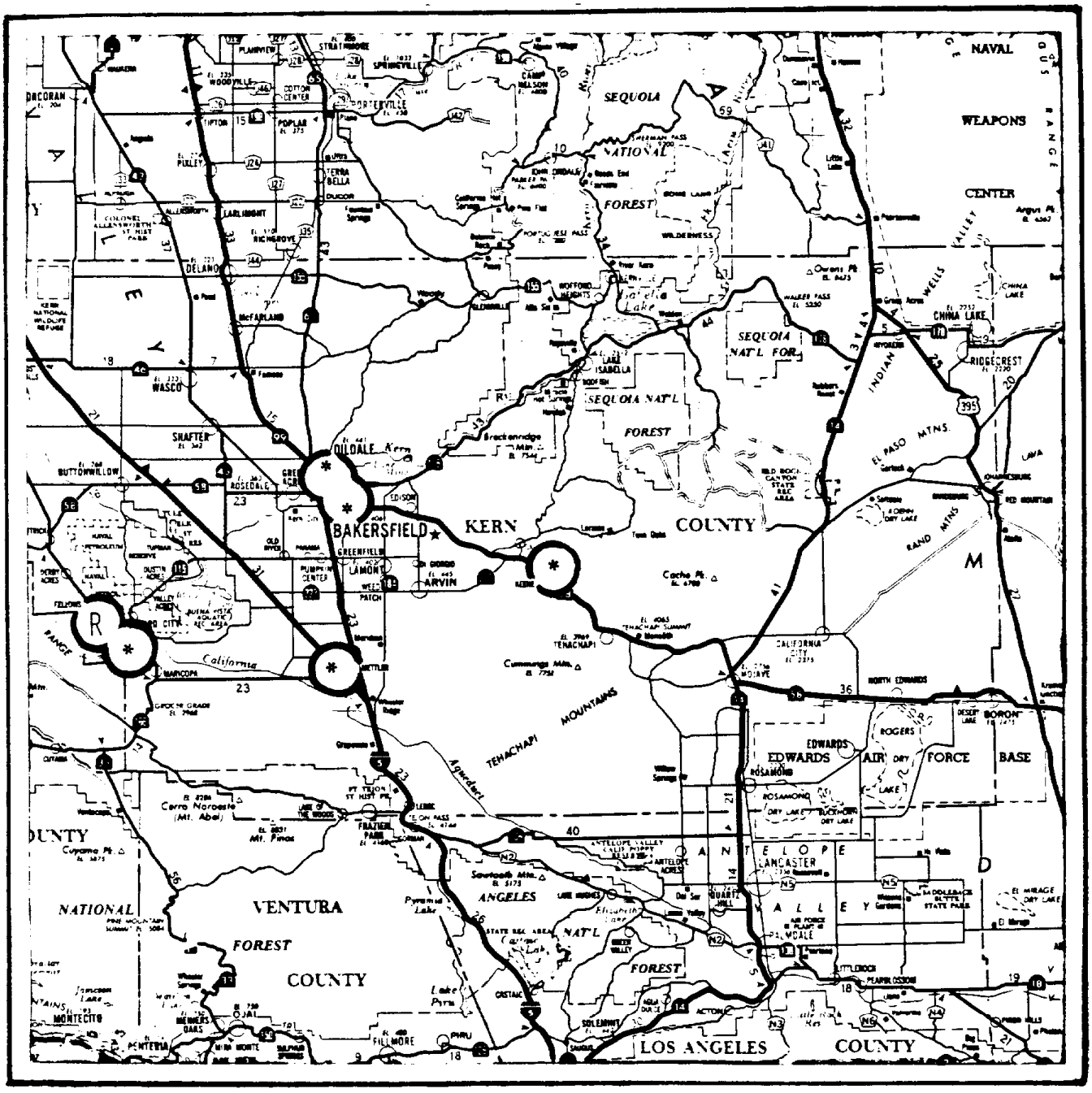
As is typical for Bakersfield during summer and early fall, the afternoon winds were from the northwest, corresponding to upslope flow. This flow transported the tracer toward the Tehachapi Mountains and the Mojave Desert. This effect can be observed most readily by examination of the hourly-averaged data collected at Keene, on the extreme eastern edge of the San Joaquin Valley. A maximum of 28 PPT was detected at Keene between 1600 and 1700 PDT. Similar concentrations were detected near Keene during Automobile Traverse 1-5 and during Airplane Traverse 1 during mid and late afternoon. Presumably, a large portion of the tracer was transported out of the San Joaquin Valley and into the Mojave Desert on the day of the release. As in the first two experiments in this intensive period, air in the vicinity of Bakersfield around mid-day



RELEASE LOCATION: 615 # SF6 AT FELLOWS
RELEASE TIME: 0107-0647 PDT, 9/14/79

* INDICATES MISSING DATA
ARROWS INDICATE BOUNDS OF SAMPLING PERIOD

Figure 3.4.20



* INDICATES SAMPLER LOCATIONS

(R) IS THE RELEASE SITE

Figure 3.4.21

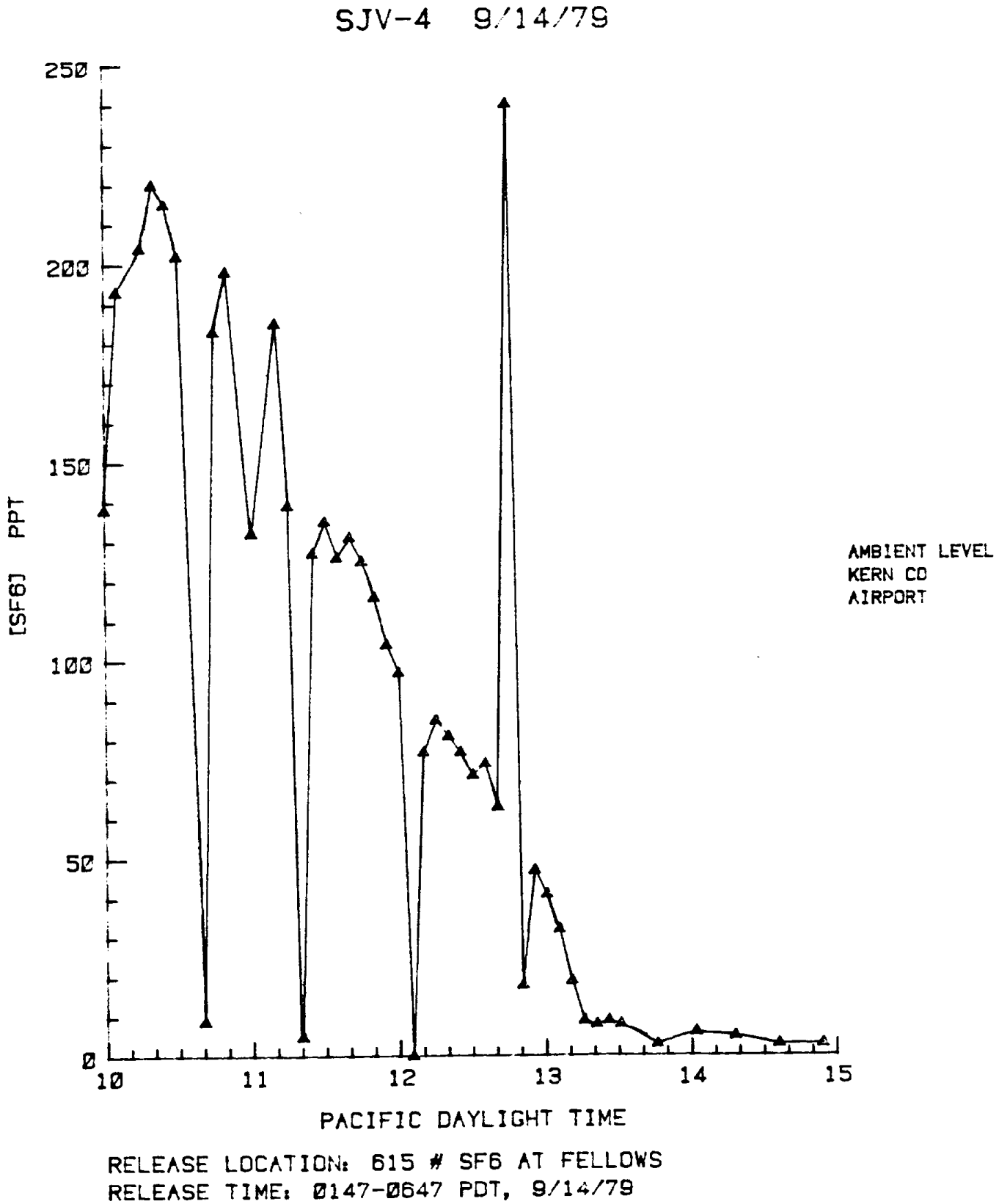

SJV-4 9/14/79
250
200
150
100
50
0
[SF6] PPT
10
11
12
13
14
15
PACIFIC DAYLIGHT TIME
AMBIENT LEVEL
KERN CO
AIRPORT
RELEASE LOCATION: 615 # SF6 AT FELLOWS
RELEASE TIME: 0147-0647 PDT, 9/14/79

Figure 3.4.22

begins to impact the western Mojave Desert by nightfall.

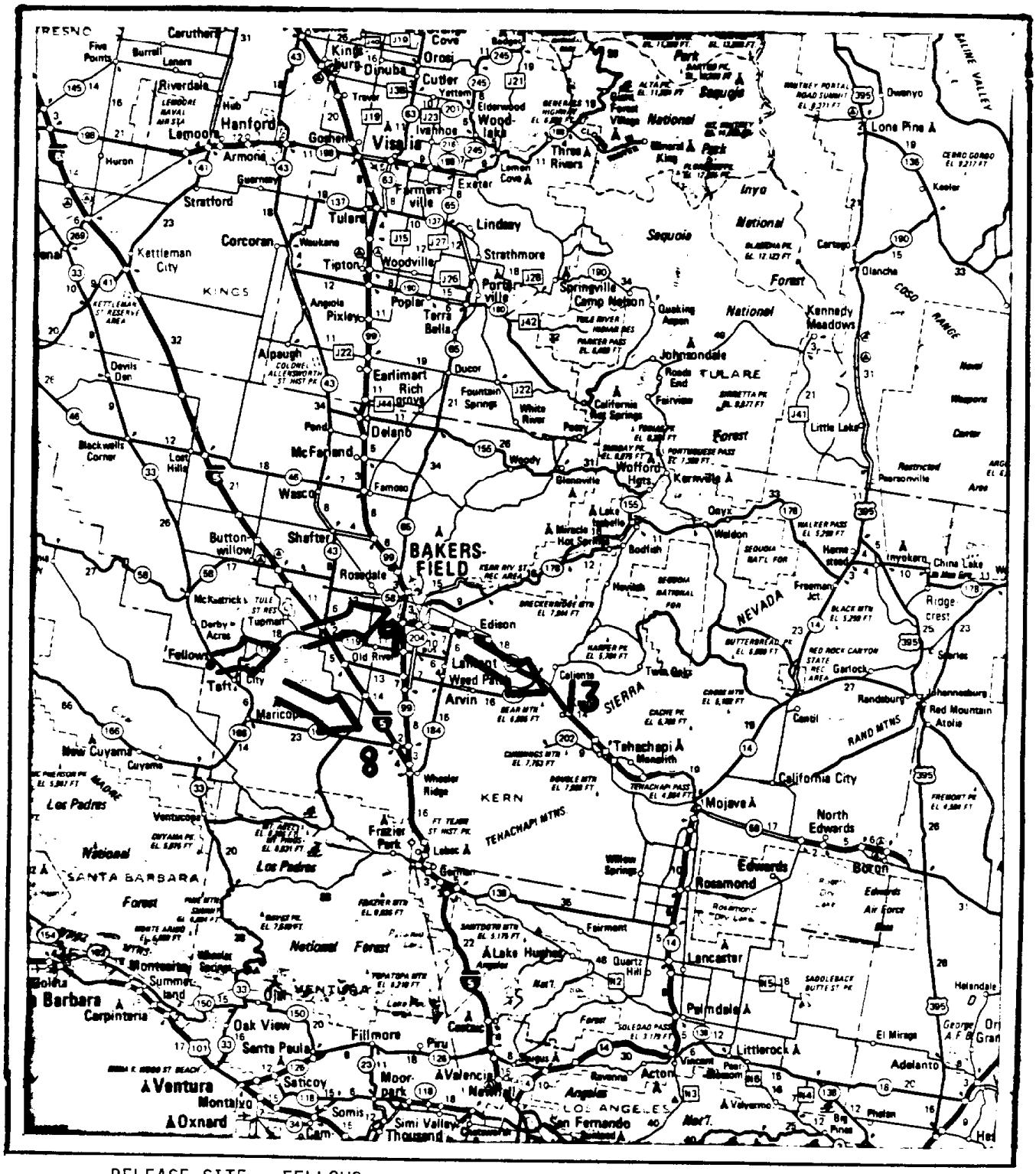
Carryover into day following the release

While most of the tracer was apparently transported out of the San Joaquin Valley during the day of the release, low but non-zero tracer concentrations were detected over large areas within the valley on the day following the release. During Automobile Traverse 2-1 and 2-3, the highest tracer concentrations were detected on the west side of the San Joaquin Valley. It was not possible to estimate the amount of tracer remaining within the valley due to the low concentrations observed.

Summary

A tracer release from the western side of the San Joaquin Valley during a nighttime drainage condition led to transport to the eastern side of the valley and eventual transport into the Mojave Desert. An overview of the tracer transport path is shown in Figure 3.4.23. The surprisingly rapid transport between the western and eastern sides of the valley was aparently without regard to the expected zone of convergence in mid-valley. It is possible that the westerly drainage winds from the release site may have over-ridden the easterly winds detected at Bakersfield, thus accounting for the apparent transport through the convergence zone. Clearly, however, the mid-valley convergence did not effectively inhibit cross-valley transport on the day of the test. In addition, a number of previously conducted tracer experiments also indicated the potential for cross-valley transport during a variety of meteorological conditions.

As in the first two experiments conducted from Oildale, afternoon winds caused the tracer to be transported to the eastern edge of the San Joaquin Valley and presumably beyond, into the Mojave Desert. A majority of the tracer was apparently transported out of the valley on the day of the release since only very low concentrations of SF6 could be detected within the San Joaquin Valley on the following day.



RELEASE SITE - FELLOWS
ARROW POINT INDICATES OBSERVED TRACER LOCATIONS
NUMBERS REFER TO HOURS AFTER RELEASE START (0107 PDT, 9/14/79)

Figure 3.4.23

3.5 Test 5 16-17 September 1979, Oildale Release (0900-1400 PDT)

3.5.1 Meteorology

General

The synoptic meteorology during the test is shown in Figure 3.5.1 and was characterized by an extraordinary flat pressure field at 500 mb over California and most of the United States as well. The gradient of 500 mb height along the west coast between the Canadian and Mexican borders was very slight. As reflected in the 850 mb temperatures plotted in Figure 2.2.1 warm, stable air covered the area of interest. At the surface, an inverted pressure trough was located over California resulting in a weak onshore pressure gradient. Clear skies prevailed throughout the region. Visibilities were generally good with Bakersfield reporting 15-30 miles and Fresno 15-40 miles. Castle AFB reported visibilities restricted to 10 miles in smoke. Maximum temperatures reported in the valley were 105°F at Bakersfield and 104°F at Fresno, over 10°F above normal for September.

Transport Winds

The surface winds from Oildale during the tracer release are tabulated in Table 3.5.1. A nocturnal drainage flow dominated the winds during this period. The flow was light and varied in direction from the east to southeast. Speeds ranged from 1-2 m/s. A light southeasterly flow continued until 1100 PDT, after which time the winds shifted to westerly and speeds increased. Afternoon surface wind speeds ranged from 3-5 m/s. The temporal variation of the winds aloft during the test can be examined from a time-height cross section of the pibal observations from Bakersfield in Figure 3.5.2. A drainage or easterly flow was evident in the first layer measured above the surface at 0100 PDT on 17 September which deepened to 265 m by the 0900 PDT observation. Transport of surface-based emissions would be contained within this layer. The easterly flow averaged above 2.5 m/s. The winds in the lower layers were in transition on the 1100 PDT observation; and by 1300 PDT, flows were generally from the northwest at all heights. The latter wind profile generally prevailed throughout the afternoon.

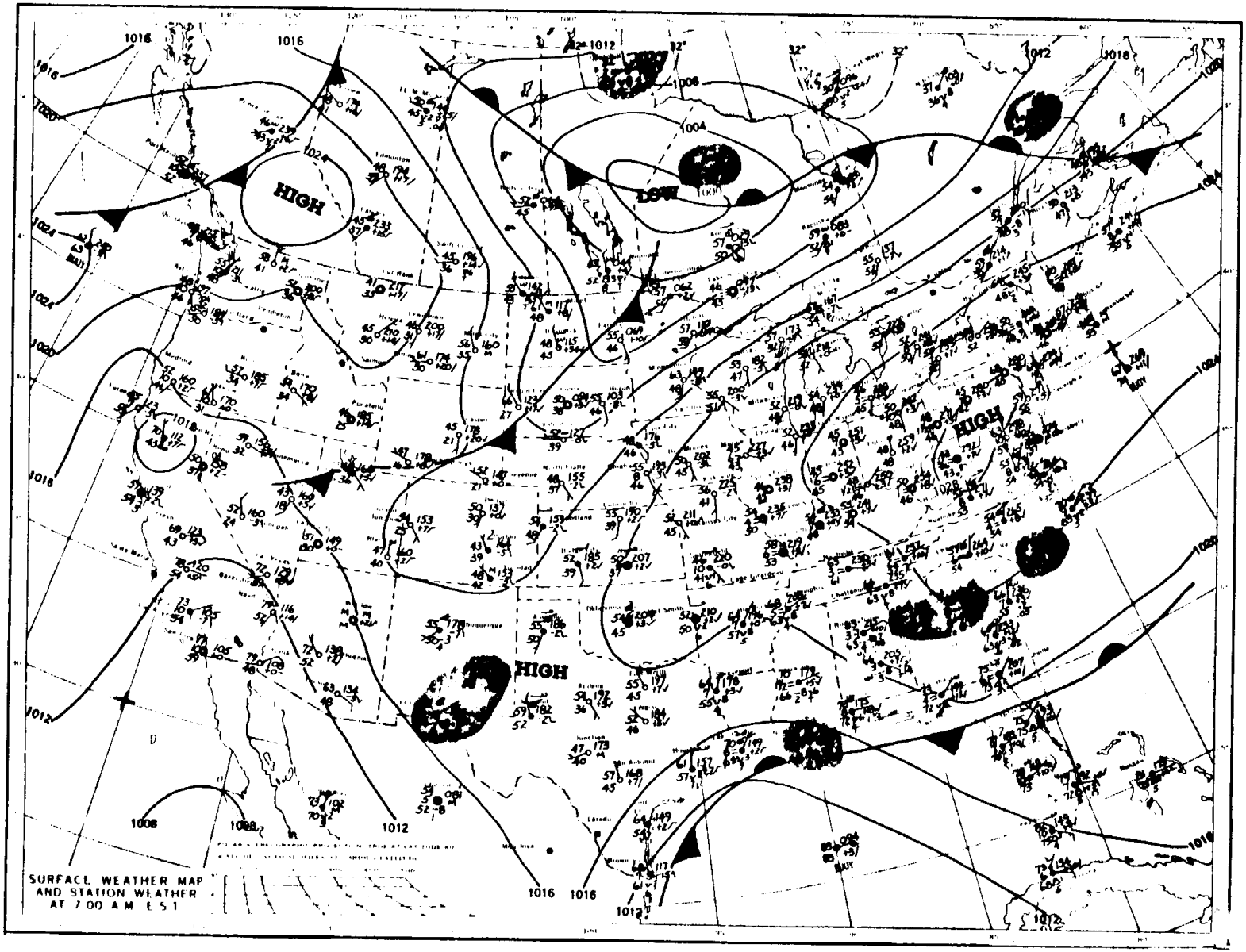


Figure 3.5.1 Surface Weather Chart - 17 September 1979 (05 PDT)

Table 3.5.1

SURFACE WINDS FROM OILDALE
16-17 SEPTEMBER 1979

Time (PDT)	Wind Direction/Speed (m/s)
	16 September 1979
2200	100/1.8
2300	105/0.9
	17 September 1979
0000	090/2.2
0200	150/0.9
0300	110/1.8

Transport on a regional basis can also be described from the streamlines constructed from the 1000 ft-agl winds. The most dominant feature of the regional flows was the development of a cyclonic flow or eddy by 2300 PDT on the 16th and the growth of that eddy to include the entire San Joaquin Valley. Before 0300 PDT, during the initial development of the eddy, the area impacted was primarily south of Visalia as shown in Figure 3.5.3. The center of convergence shifted northward during the night and developed such that the entire valley was under the influence of the eddy (Figure 3.5.4). Remnants of the eddy persisted until 1300 PDT. The afternoon flow was characterized by the typical northwest streamfield shown on Figure 3.5.5. The winds from the two pibal sites located in the foothills on either side of the valley (Caliente and Taft) show a strong component of the flow directed upslope.

Mixing Heights

Mixing heights on the 17th, estimated from the aircraft data are shown in Table 3.5.2. Heights were generally low in the 200-400 m range. Mixing heights were larger than observed in the previous tests, marking the end of the stable temperatures period aloft.

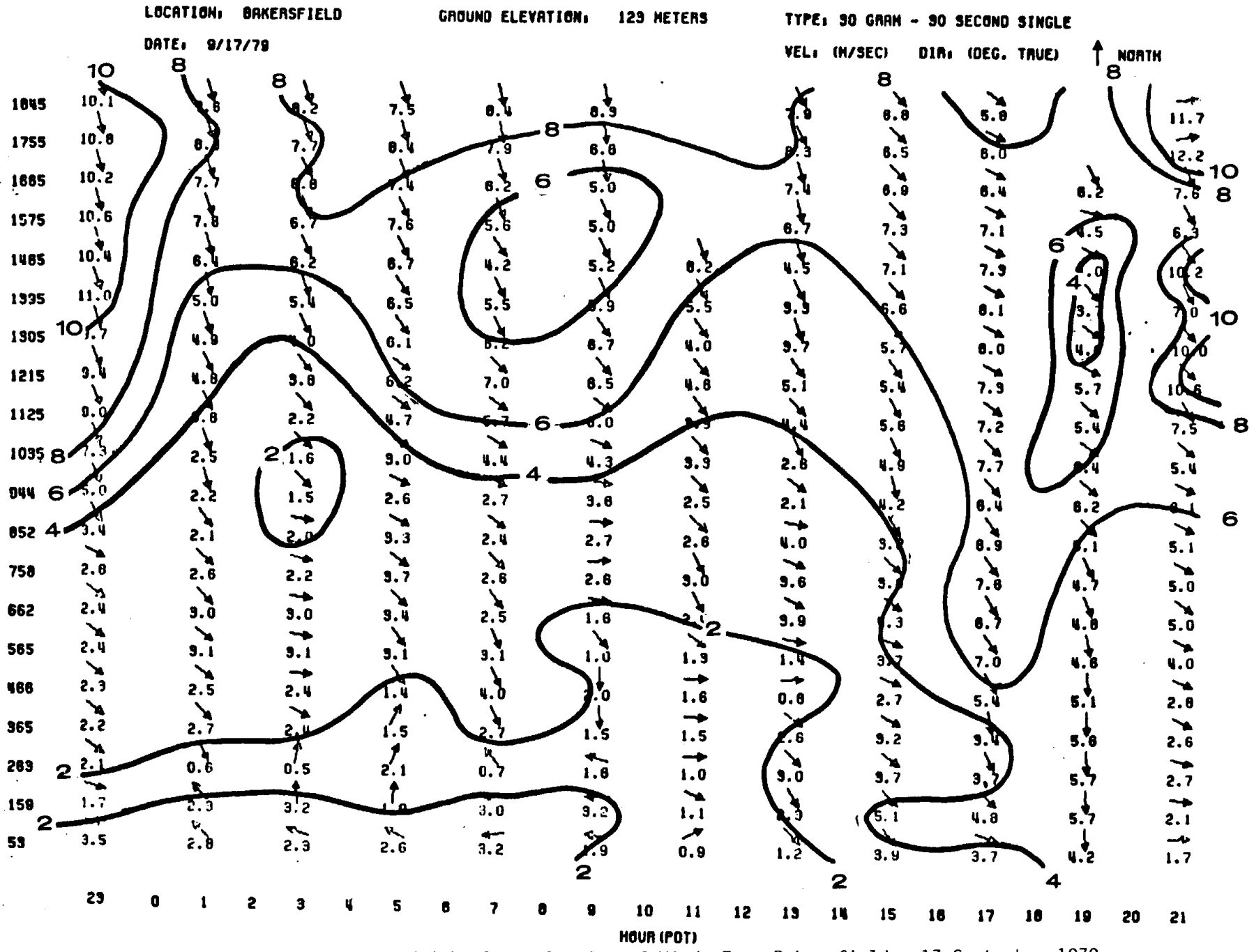


Figure 3.5.2 Time-Height Cross Section of Winds From Bakersfield - 17 September 1979

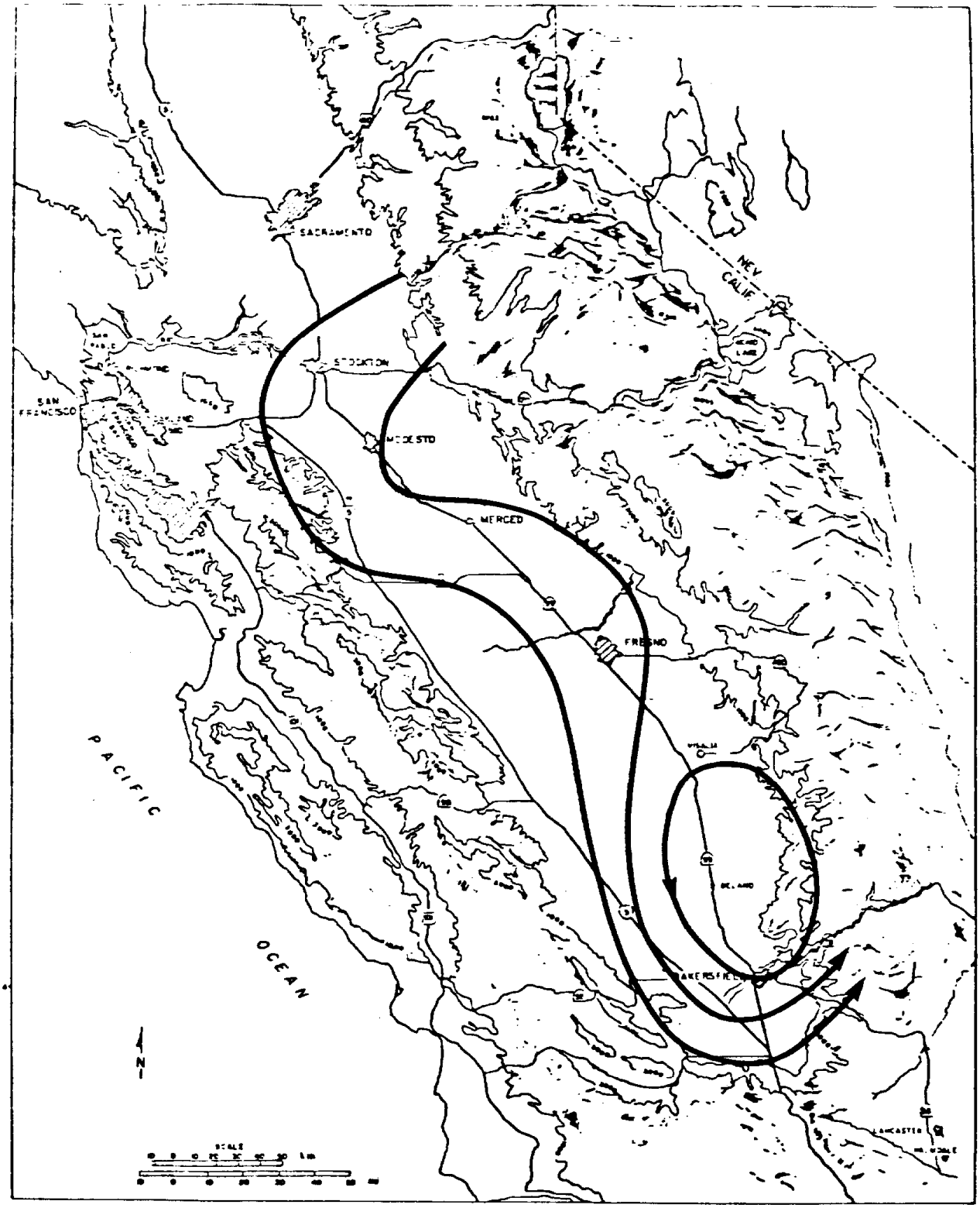


Figure 3.5.3 1000 Ft-agl Streamlines - 17 September 1979 (01 PDT)

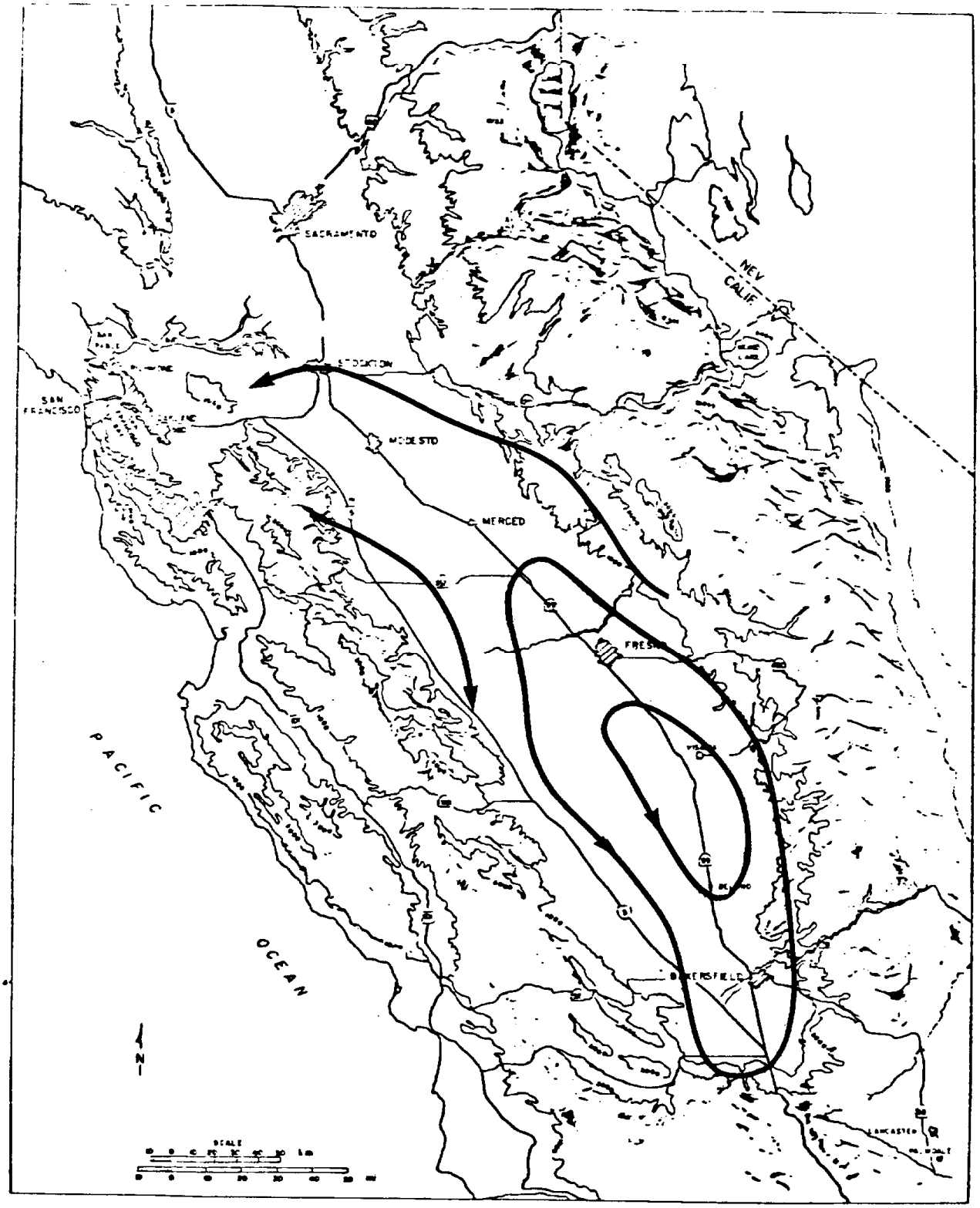


Figure 3.5.4 1000 Ft-agl Streamlines - 17 September 1979 (05 PDT)

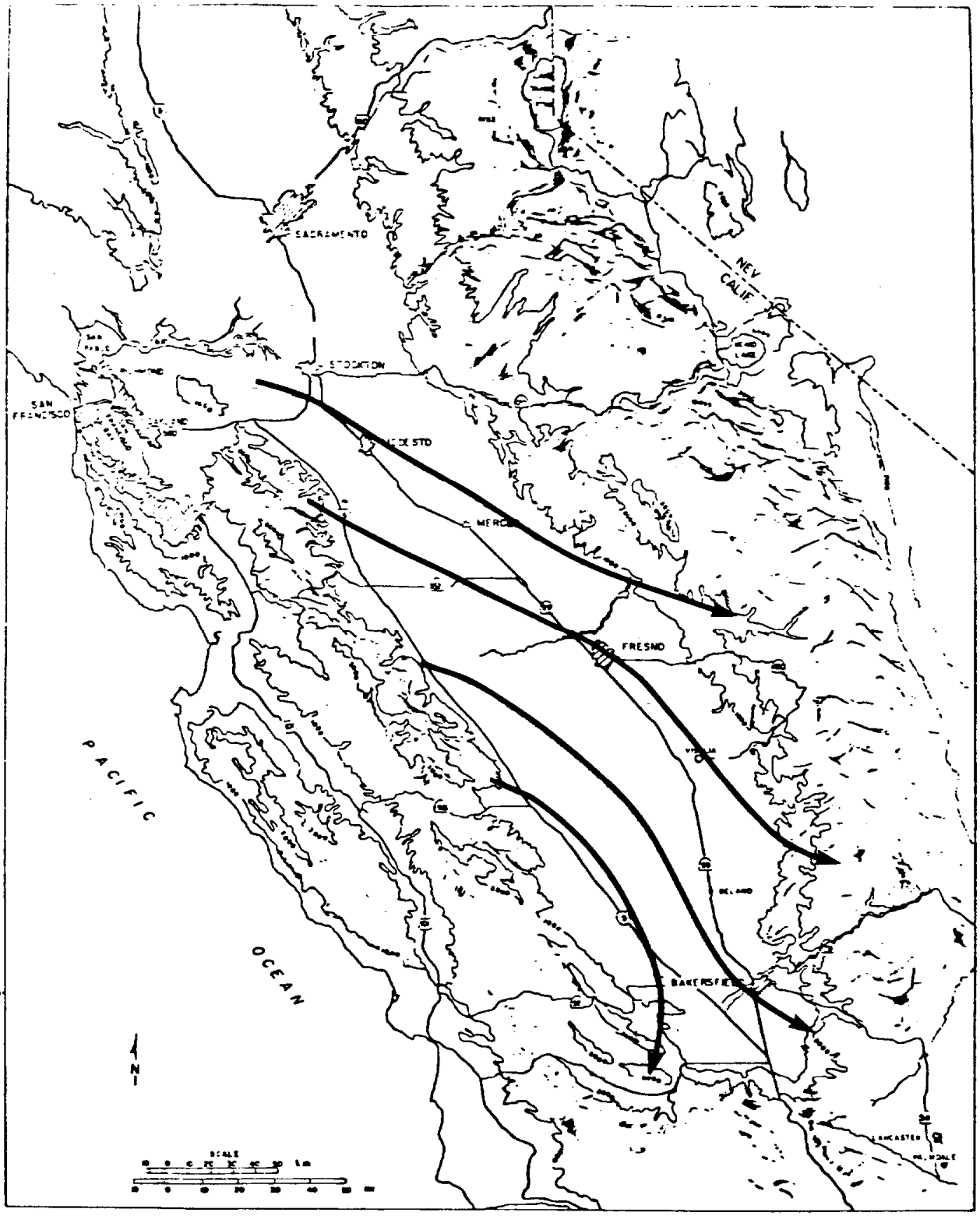


Figure 3.5.5 1000 Ft-agl Streamlines - 17 September 1979 (17 PDT)

Table 3.5.2

AIRCRAFT MIXING HEIGHTS
SEPTEMBER 17, 1981

Time (PDT)	Location *	Mixing Height (m [above ground level])
1417	4 NW Bakersfield Airport	1100
1455	Taft	>1500
1617	Caliente	>1500
1745	4 NW Bakersfield	1000

(* Distances in miles)

3.5.2 Air Quality

Regional Pollutant Levels

Maximum hourly average ozone concentrations for 17 September are shown on Figure 3.5.6. The only violations of the California air quality standard were experienced in the Fresno urban area where a maximum concentration of .13 ppm was reported. Table 3.5.3 shows the maximum hourly concentrations for SO_2, CO and NO_x observed anywhere in the valley on September 16. Also shown are the maximum hourly values recorded at the three Rockwell International vans. All pollutant concentrations except CO were lower than observed in the previous two tests. A value of 6 ppm for CO at Visalia is quite high for that area.

Aircraft Sampling

In support of a morning tracer release from Oildale, the MRI aircraft sampled that afternoon (1415-1800 PDT) in the South San Joaquin Valley and into the Tehachapi Pass. Constant altitude traverses were flown within the mixing layer to define the horizontal distribution of pollutants and spirals over Bakersfield, Taft, Caliente, and Tehachapi defined the vertical extent and distribution of pollutants. Figure 3.5.7 shows the sampling route for the flight. A summary of observed pollutant characteristics appears in Table 3.5.4. Aircraft soundings made during the flight are shown in Figures 3.5.8 to 3.5.11.

Table 3.5.3

MAXIMUM HOURLY CONCENTRATIONS
SEPTEMBER 16, 1979

Parameter	Location	Maximum Value (ppm)
SO_2	Bakersfield	.02
CO	Visalia	6
NO_x	Bakersfield	.23
SO_2	Arvin (RI)	.01
SO_2	Lost Hills (RI)	< .01
NO_x	Arvin (RI)	.01
NO_x	Lost Hills (RI)	.03
NO_x	Reedley (RI)	.03

Turbulent mixing through a deep layer was observed at Taft (1860 m-msl), Caliente (>2100 m-msl), and Tehachapi (>3000 m-msl). Over Bakersfield mixing was observed to 1220 m (msl) at the start of sampling and decreased to 1060 m (msl) by the end of the sampling. Within the surface mixing layers, average ozone concentrations were about .11-.12 ppm over Bakersfield, .15 ppm on the west side over Taft, and .13 ppm in the east side mountain pass. Maximum ozone concentrations (in excess of .16 ppm) were measured over Caliente and Tehachapi. A large forest fire was ongoing near Lake Isabella some 30 nm north of Tehachapi and the fire plume was visually observed at 3000 m (msl) over that sampling location. However, the impact of the plume on the air quality is not evident. The intrusion of the valley air into the mountain pass, on the other hand, is readily apparent on the traverse between Tehachapi and Caliente, as well as the spirals at those sampling locations (Figure 3.5.10). Average ozone concentrations in excess of .13 ppm were measured through the pass. Only low background concentrations of NO_x and SO_2 were observed throughout the sampling.

A sampling traverse was made from Arvin to the VOR (1729 PDT) in an attempt to longitudinally transect the urban plume. However, it appears that by late in the afternoon the urban air has been transported away from the source and only traces of the polluted air were found near the start of the pass.

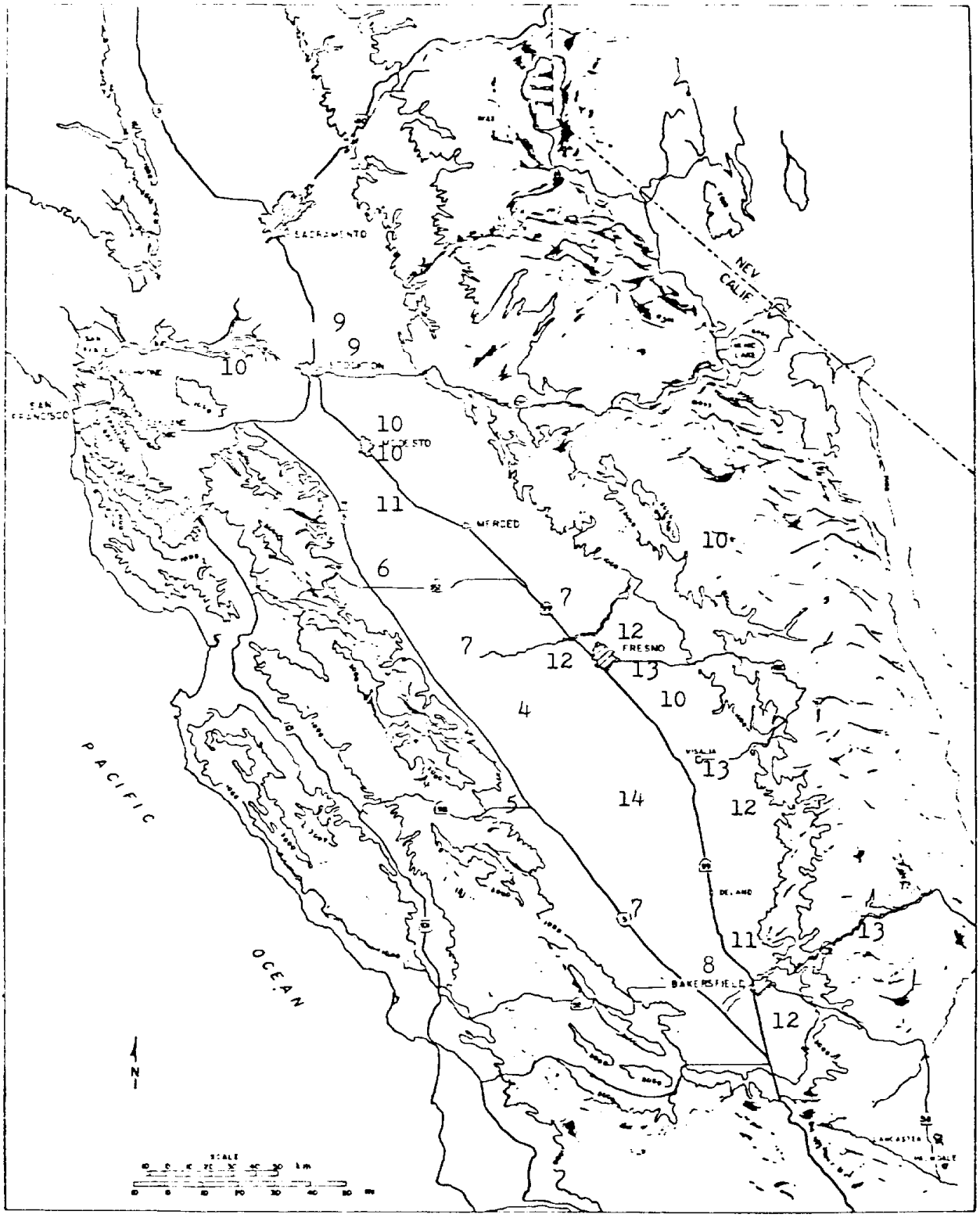
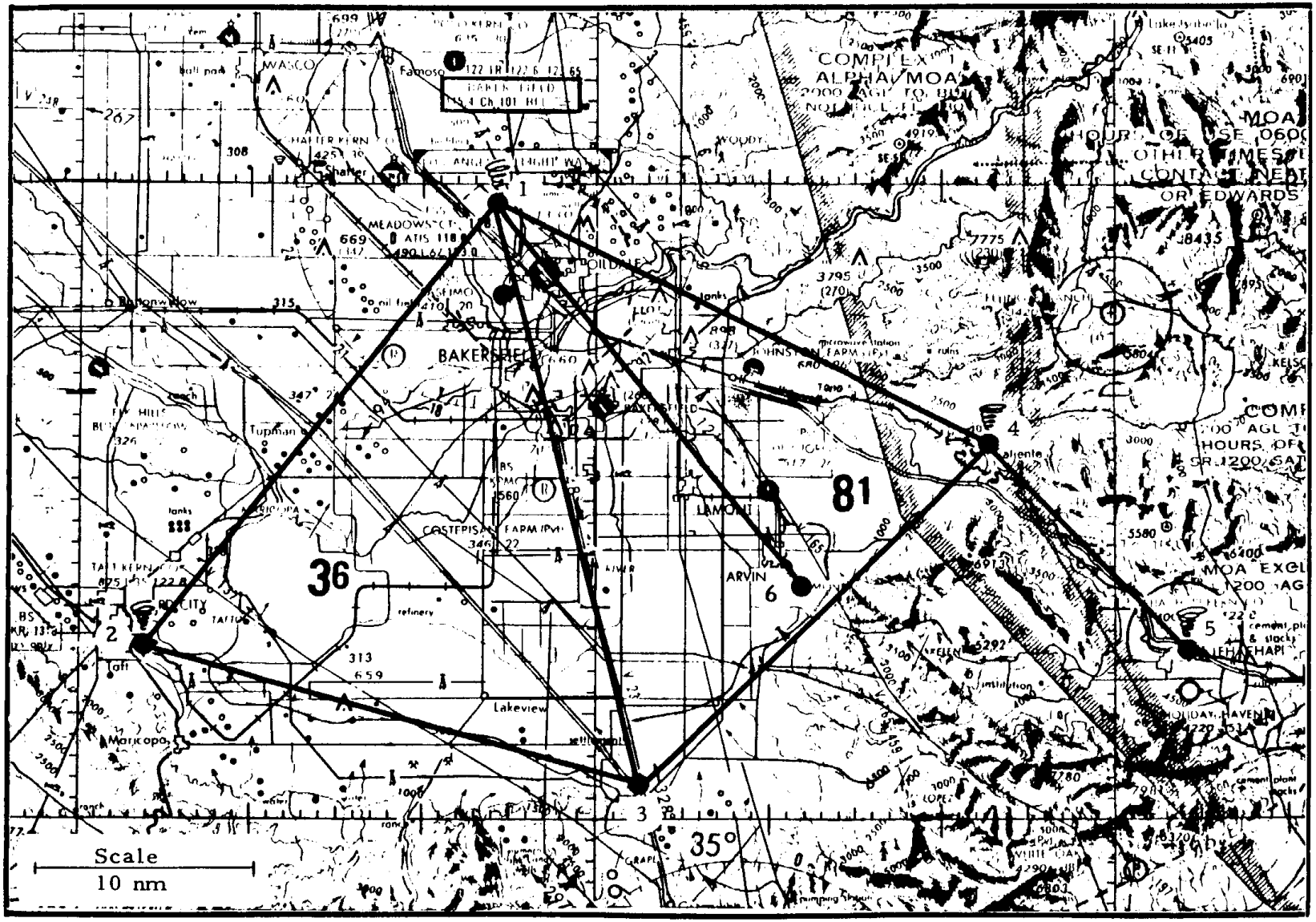


Figure 3.5.6 Maximum Hourly Ozone Concentrations (pphm) - 16 September 1979



SAMPLING ROUTES 17 SEPTEMBER 1979

Figure 3.5.7

Table 3.5.4

AIR QUALITY MEASUREMENTS CARB SAN JOAQUIN VALLEY PROJECT
SEPTEMBER 17, 1979 SAMPLING

Start Time (PDT)	Location (Point)	O_3 Mean (ppb)	O_3 Max (ppb)	b_{scat} Mean ($x10^{-6}m^{-1}$)	b_{scat} Max ($x10^{-6}m^{-1}$)	SO_2 Mean (ppb)	SO_2 Max (ppb)	NO_x Mean (ppb)	NO_x Max (ppb)	NO Mean (ppb)	NO Max (ppb)
1417	1	93	121	68	172	1	2	8	22	1	12
1438	1-2	112	150	83	284	1	2	8	47	2	16
1456	2	128	150	77	134	1	2	10	24	1	11
1525	2-3	124	152	91	186	2	20	13	22	2	12
1543	3-1	111	133	82	144	1	1	16	38	1	11
1603	1-4	104	145	84	164	1	15	14	45	2	11
1618	4	125	164	99	174	2	3	16	31	3	15
1640	5	139	166	104	168	1	3	10	19	3	11
1656	5-4	131	149	94	152	2	3	13	30	2	12
1708	4-3	118	140	91	152	2	3	12	20	-1	0
1729	6-1	87	117	68	172	2	5	12	27	4	12
1746	1	80	99	57	144	0	2	7	15	4	13

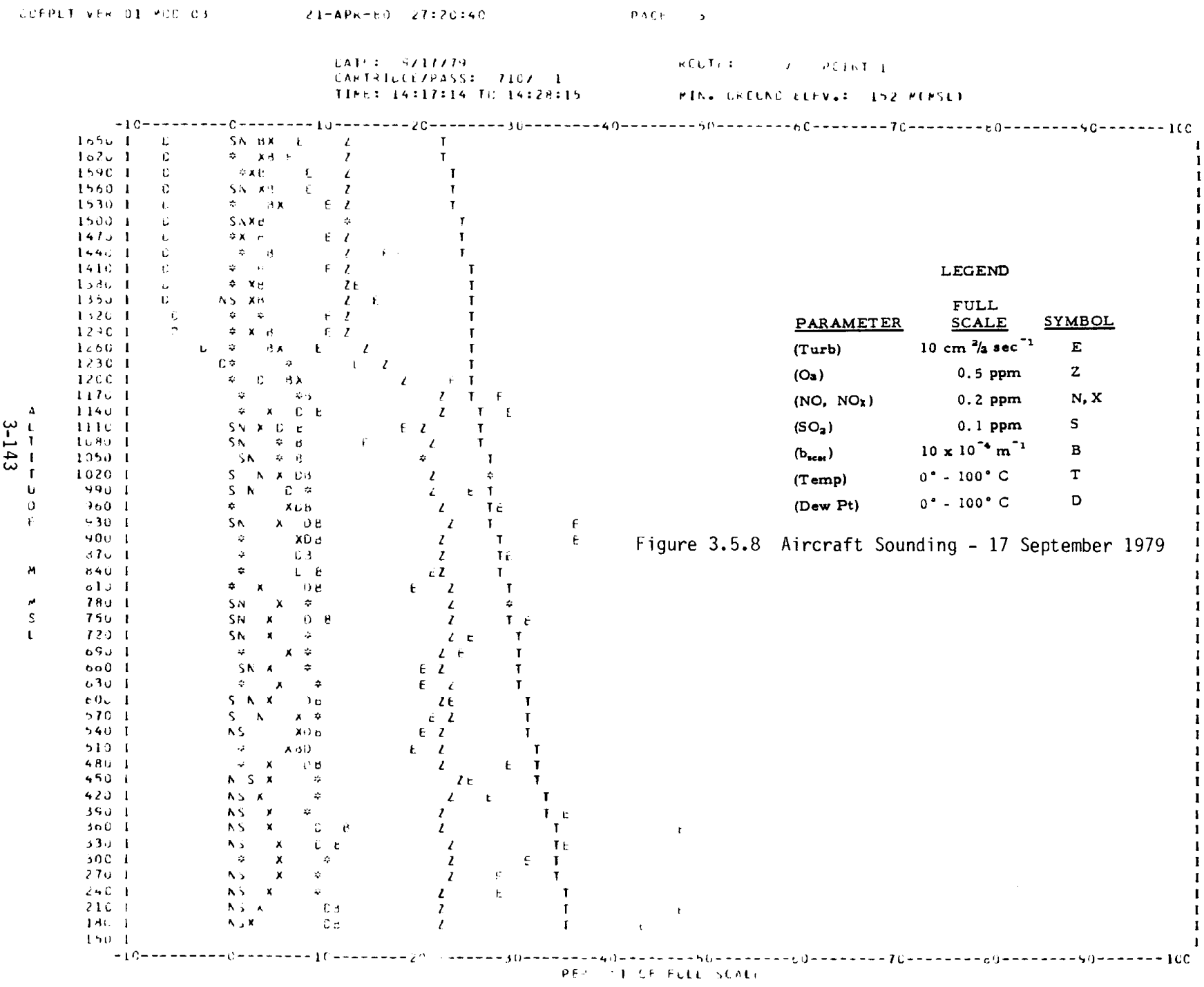
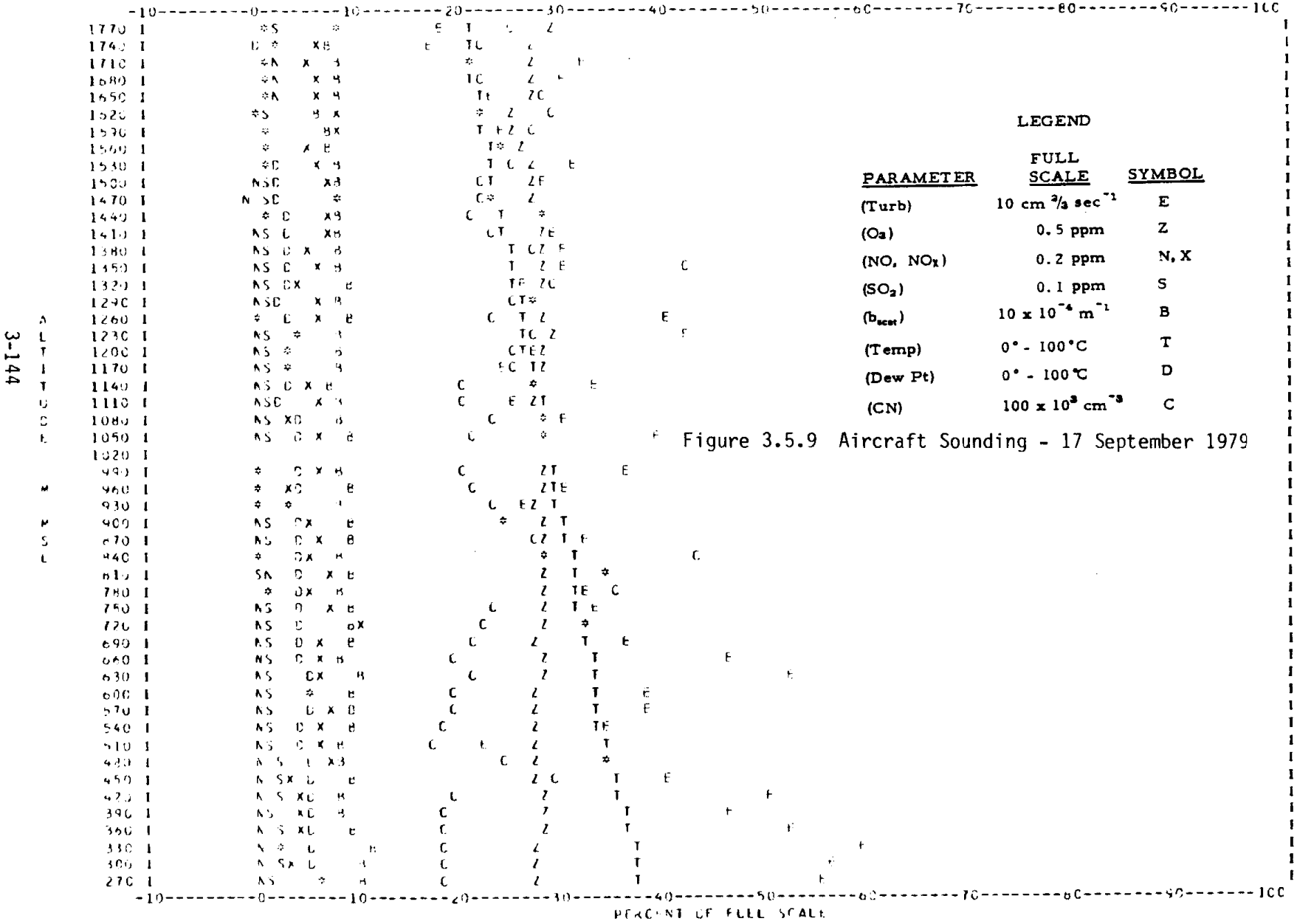


Figure 3.5.8 Aircraft Sounding - 17 September 1979

DATE: 9/17/79 ROUTE: [illegible]
CARTRIDGE/PASS: 7107 3
TIME: 14:5?:42 TO 15: 7: 1 MIN. GROUND ELEV.: 266 M(MSL)



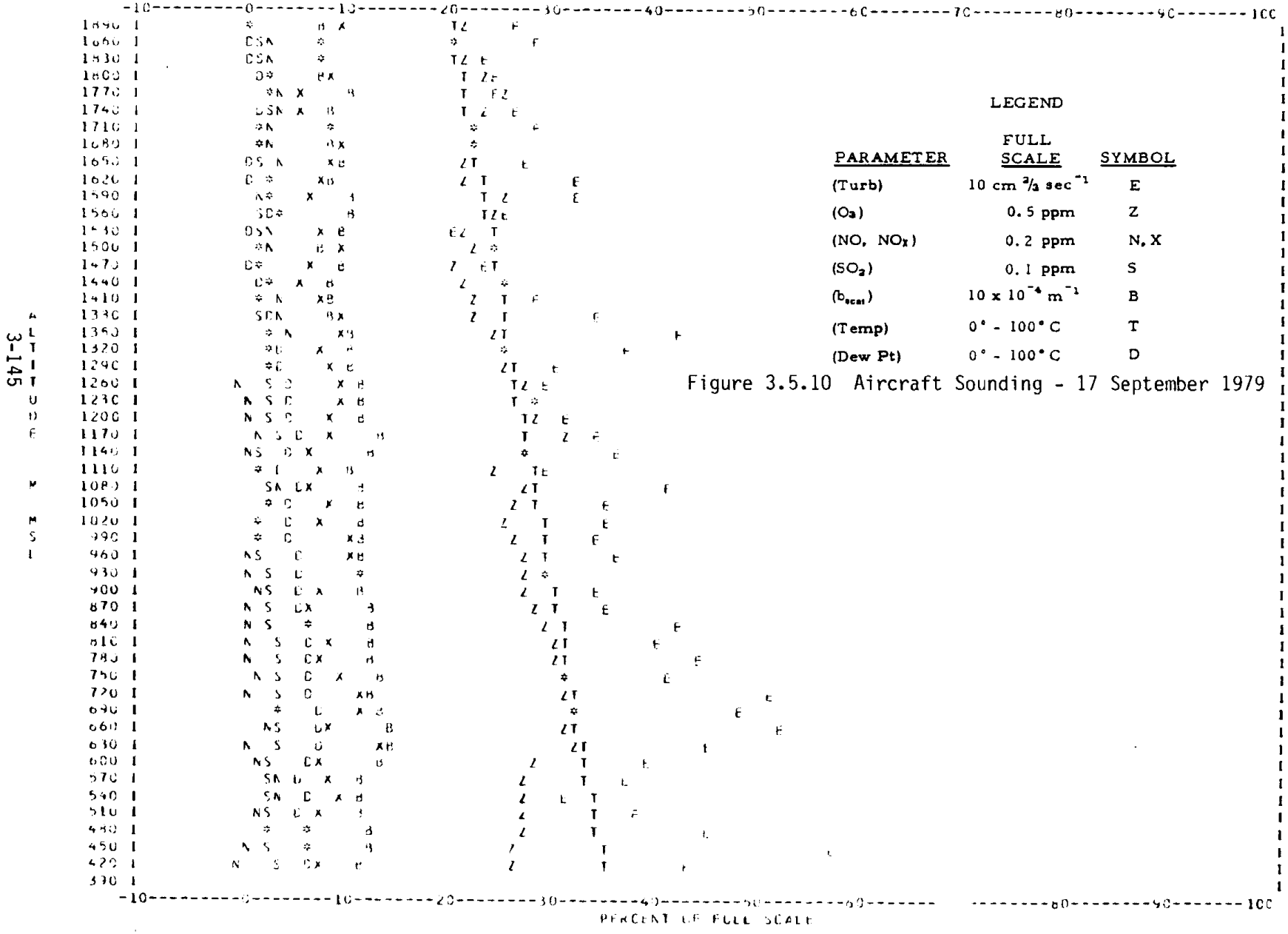
LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2}/_{3}$ sec^{-1}	E
(O_3)	0.5 ppm	Z
(NO, NO_x)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100°C	T
(Dew Pt)	0° - 100°C	D
(CN)	100 x 10^{3} cm^{-3}	C

Figure 3.5.9 Aircraft Sounding - 17 September 1979

DATE: 9/17/79
CARTRIDGE/PASS: 7107 8
TIME: 16:17:34 TO 16:29: 5

ROUTE: [illegible]
MIN. GROUND ELEV.: 396 M(MSL)



LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec^{-1}	E
(O_3)	0.5 ppm	Z
(NO, NO_X)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100°C	T
(Dew Pt)	0° - 100°C	D

Figure 3.5.10 Aircraft Sounding - 17 September 1979

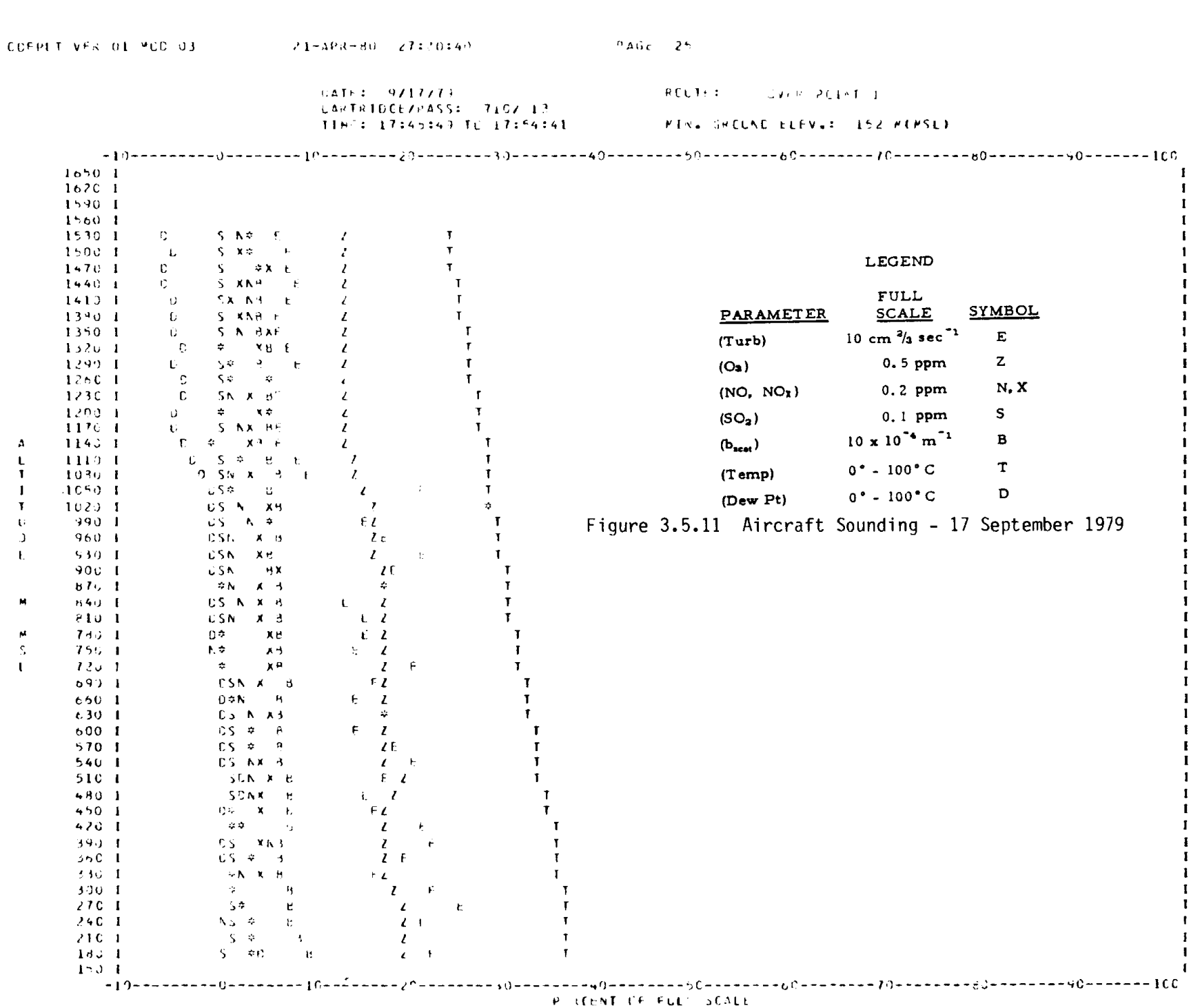


Figure 3.5.11 Aircraft Sounding - 17 September 1979

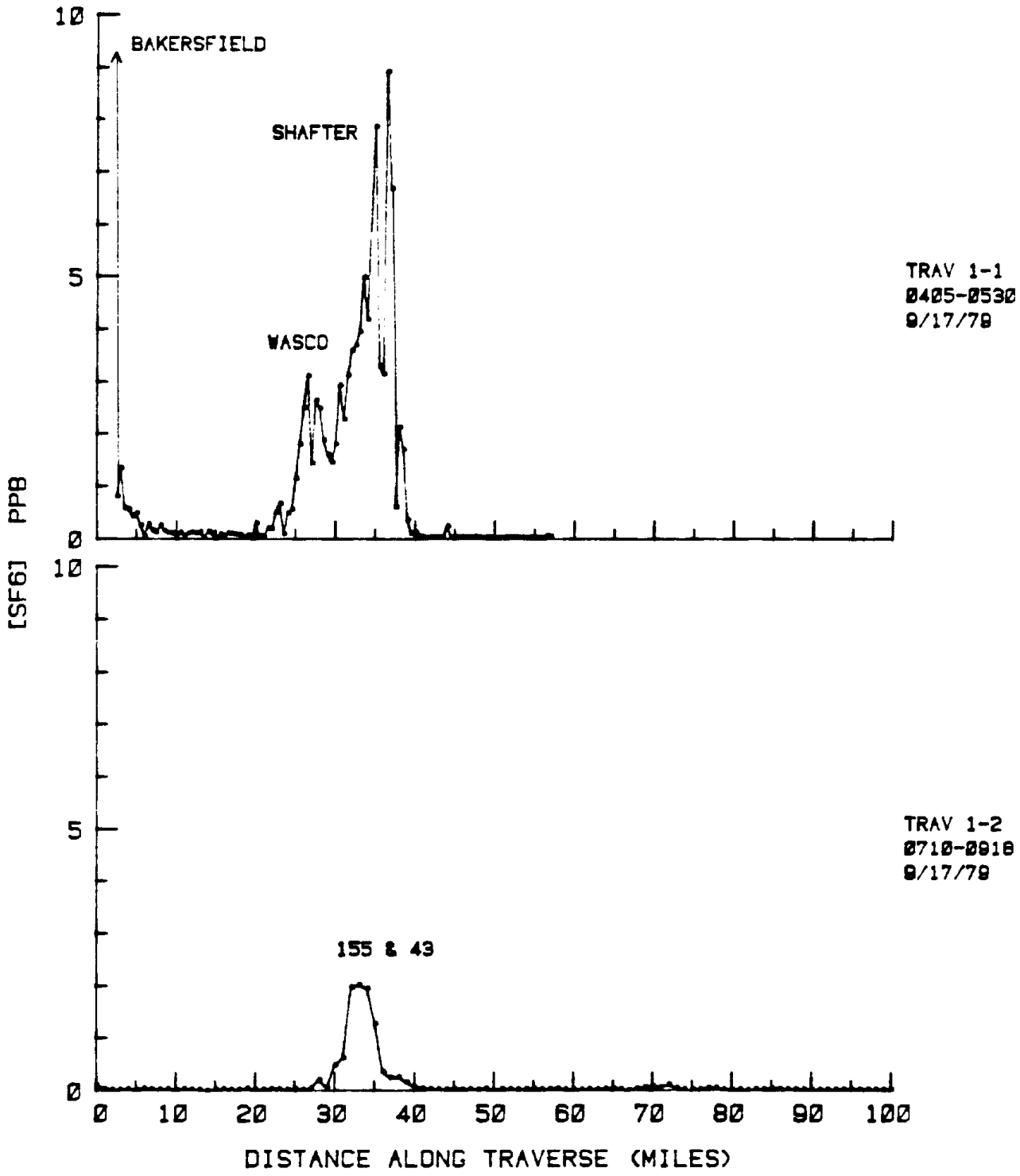
3.5.3 Tracer Test 5

Release Location: Oildale, Kern County
Time and Date: 2200-0337 PDT, 9/16/79-9/17/79
Release Amount: 106 lbs SF6/hr
Release conducted during southeasterly drainage winds.

Initial Transport northwest of release site

During two previous experiments conducted from Oildale, the tracer was initially transported towards the center of the valley and then up and over the Tehachapi Mountains during the afternoon upslope winds. In order to determine the transport path of pollutants emitted into the start of the nighttime drainage winds, this release was conducted beginning at 2200 PDT. As in the two previous releases from Oildale, all traverses were dispatched from the Kern County Airport, approximately 1/2 mile west of the release site. While this did not pose any problem during either of the previous two tests from Oildale, during this experiment the tracer plume impacted the airport area directly, leading to local tracer concentrations in excess of about 100 PPB. Because of the high concentrations, all samples located at the airport were contaminated. Contamination led to a background concentration of between 10 and 100 PPT, i.e. a sample which should indicate no SF6, would instead indicate between 10 and 100 PPT. Thus the only samples that provided useful information were hourly-averaged samples (which were located elsewhere and not contaminated), and those traverse samples whisch showed concentrations well in excess of the contaminated background levels.

Samples collected during Traverse 1-1 and 1-2 are shown in Figure 3.5.12. These traverses show that extremely high tracer concentrations were detected northwest of the release site. During Traverse 1-1, a maximum concentration of about 8900 PPT (12200 PPT/lb-mole SF6 released/hr) was detected near Shafter at about 0500 PDT. Tracer concentrations near Wasco during the same traverse were between 2000 and 3000 PPT. This agrees well with the hourly-averaged tracer concentration detected at Wasco (see Figure 3.5.13), where 1815 PPT was detected between 0400 and 0500 PDT, and 3500 PPT (4800 PPT/lb-mole SF6 released/hr) was detected between 0500 and 0600 PDT. The average concentration



RELEASE LOCATION: 597 # SF6 AT OILDALE
RELEASE TIME: 2200-0337 PDT, 9/16-17/79

Figure 3.5.12

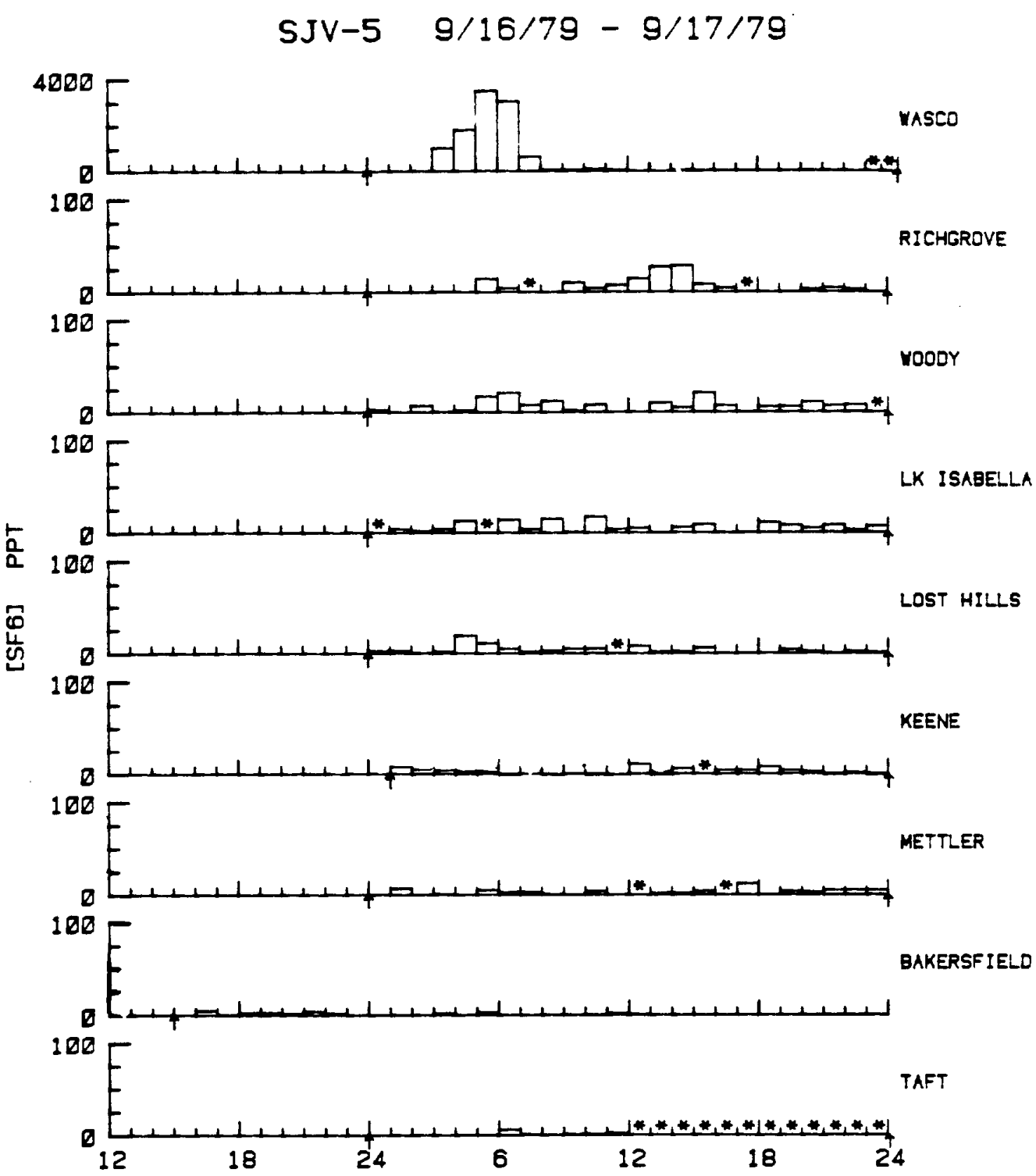
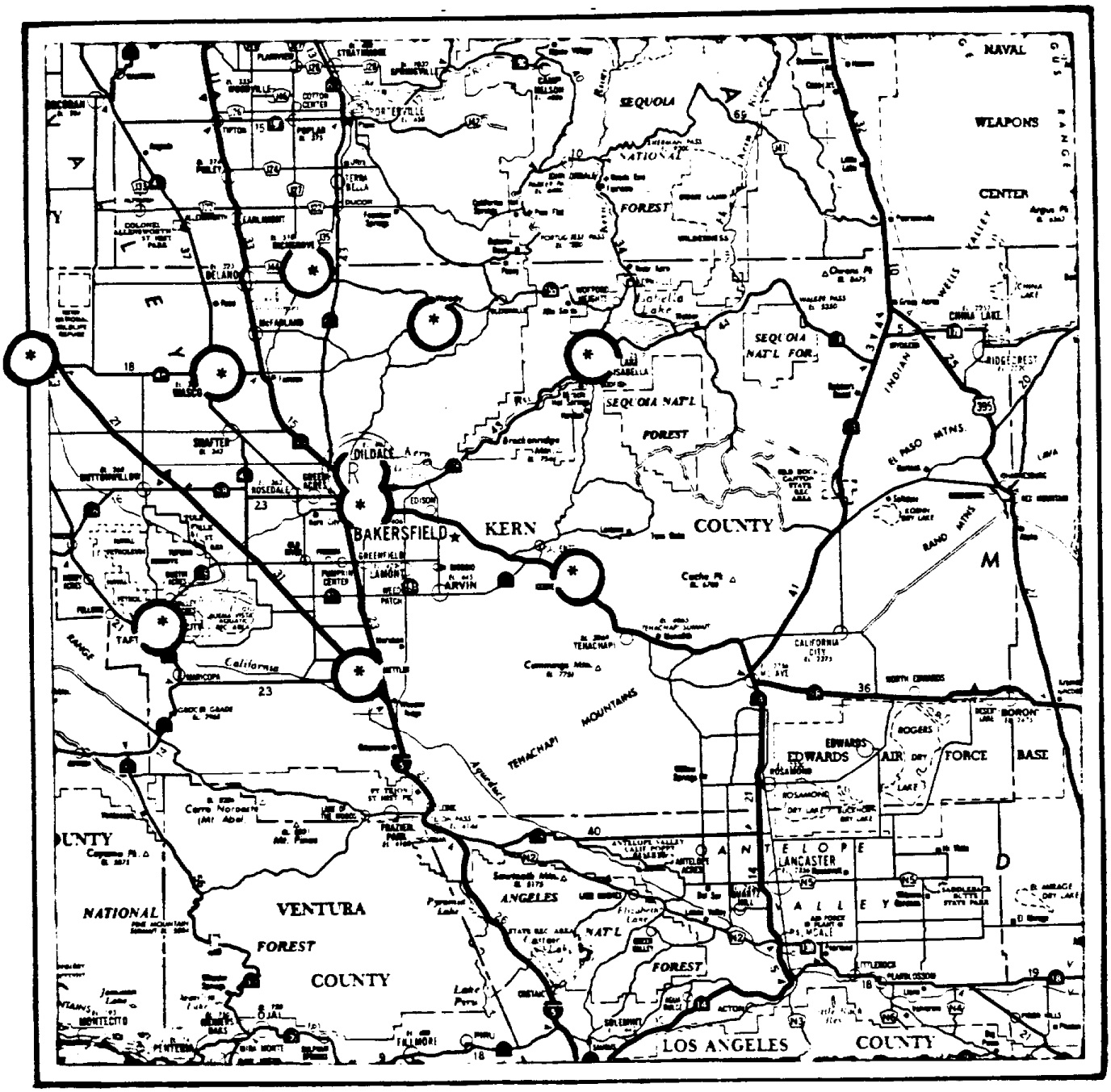

SJV-5 9/16/79 - 9/17/79
4000
0
100
0
WASCO
RICHGROVE
WOODY
LK ISABELLA
LOST HILLS
KEENE
METTLER
BAKERSFIELD
TAFT
[SF6] PPT
12
18
24
6
12
18
24
PACIFIC DAYLIGHT TIME
RELEASE LOCATION: 597 # SF6 AT OILDALE
RELEASE TIME: 2200-0337 PDT, 9/16-17/79
* INDICATES MISSING DATA
ARROWS INDICATE BOUNDS OF SAMPLING PERIOD
LOCATIONS ORDERED BY RELATIVE IMPACT

Figure 3.5.13

SJV
5



(•) INDICATES SAMPLER LOCATIONS

(R) IS THE RELEASE SITE

Figure 3.5.14

detected at Wasco between 0300 and 0700 PDT was 2400 PPT (3300 PPT/lb-mole SF6 released/hr). Wasco lies about 21-22 miles northwest of the release site, thus the arrival of SF6 about 5 hours after the start of the release corresponds to a mean transport wind speed of about 4-4.5 miles/hr. This can be compared to the 1-2 mps (2.2-4.4 miles/hr) surface wind speeds at Bakersfield and the 2.5 mps (5.5 miles/hr) winds averaged over the height of the drainage layer. The depth of the surface drainage flow was about 1000 ft. Using the Gaussian plume model, the predicted centerline concentration under stable atmospheric conditions (Pasquill Gifford Stability Class E or F) and a 1000 ft mixing height, agrees very well with the average tracer concentration detected at Wasco. It was not possible to compare the lateral dispersion of the tracer to that predicted by the Gaussian plume model because of the limited amount of uncontaminated data. The tracer was detected even further north of the release site during Automobile Traverse 1-2 in which 2000 PPT (2750 PPT/lb-mole released/hr) was detected a few miles west of Delano at the intersection of Hwy's 155 and 43. A small amount of tracer was also transported to the western side of the San Joaquin Valley in that a maximum concentration of 19 PPT was detected at Lost Hills between 0400 and 0500 PDT (see Figure 3.5.13). Clearly, the tracer was effectively transported by the nighttime drainage winds into the center of the valley northwest of the release site.

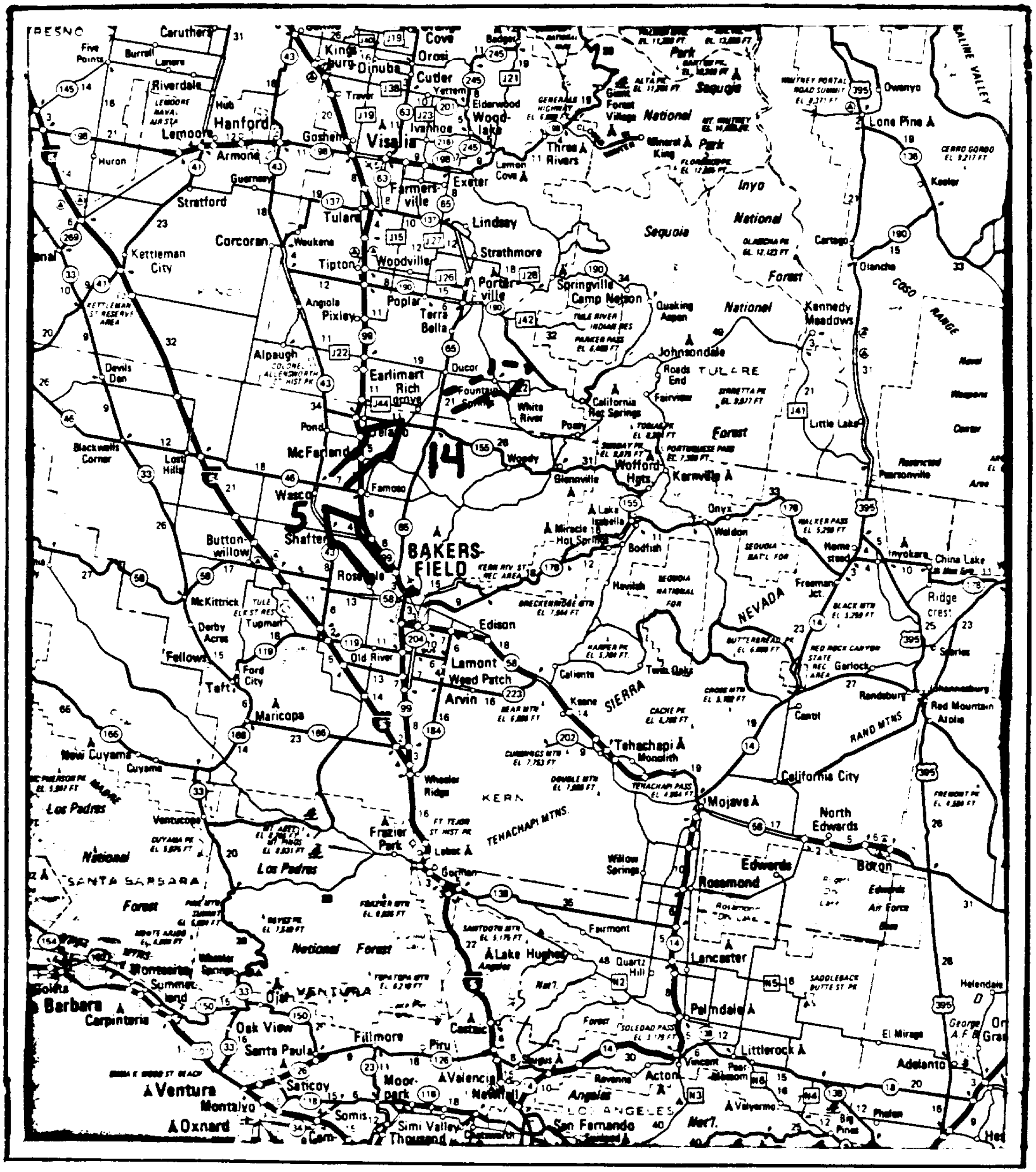
Transport during afternoon upslope flow

Because of the deep penetration of the tracer into the center of the valley, the afternoon upslope flow did not lead to transport back across the release site and over the Tehachapi Mountains. As shown in Figure 3.5.13, the hourly-averaged sampler at Bakersfield showed essentially no SF6 throughout the entire test period. During the afternoon following the release only Wasco and Richgrove detected significant quantities of the tracer. A maximum of 28 PPT was detected at Richgrove between 1400 and 1500 PDT. Richgrove lies about 25 miles directly north of the release site, on the eastern edge of the valley. The detection of tracer at this location indicates that much of the tracer may have been transported into the Sequoia National Forest, east of Richgrove and Porterville. The low concentrations detected at Porterville and Wasco during the afternoon indicate that the tracer was quickly dispersed both vertically

and laterally during the more unstable afternoon atmospheric conditions (i.e. more unstable than the atmospheric conditions prevailing during the release).

Summary

A tracer release from Oildale near the beginning of the nighttime downslope flow led to a deep penetration of the tracer into the center of the San Joaquin Valley. An overview of the tracer transport and dispersion during this experiment is shown in Figure 3.5.15. The tracer was limited to a shallow layer about 1000 ft thick. The combination of limited vertical mixing and limited lateral dispersion due to stable atmospheric conditions, led to very high tracer concentrations in the center of the valley. At Wasco, 4800 PPT/lb-mole of SF6 released/hr was detected between 0400 and 0500 PDT. The deep penetration of the tracer also led to an afternoon impact that was further north than during either of the previous releases from Oildale. The slopes of the Sequoia National Forest south of the National Park areas appeared to be impacted by the tracer during the afternoon upslope flow. Afternoon tracer concentrations, at least at the hourly-averaged sampling sites, were about 2 orders of magnitude lower than the early morning concentrations observed. This suggests that the tracer dispersed rapidly during the unstable afternoon conditions.



RELEASE SITE - OILDALE
ARROW POINT INDICATES OBSERVED TRACER LOCATIONS
NUMBERS REFER TO HOURS AFTER RELEASE START (2200 PDT, 9/16/79)

Figure 3.5.15

3.6 Test 6 21-22 September 1979, Manteca Release (0900-1400 PDT)

3.6.1 Meteorology

General

The synoptic meteorology during this test was characterized by the passage of a weak short wave trough aloft over central California. As can be seen from the weather charts on Figure 3.6.1, the trough was superimposed on a long wave ridge at the 500 mb level which existed along the west coast of Canada and the U.S. At 0500 PDT the trough had moved onshore and was located just east of San Francisco. This disturbance was one of a series of impulses originating in the Gulf of Alaska which for several days prior had been cooling temperatures aloft in central California. This trend is shown in the 850 mb temperatures from Oakland and Vandenberg plotted on Figure 2.2.1. The upper level disturbance is reflected at the surface as a weak trough. At the map time of Figure 3.6.1 (0500 PDT), the trough was oriented northeast-southwest across central California. Nevertheless, skies remained cloudless throughout the test. Visibilities were relatively poor, ranging from 7-10 miles in the valley. Maximum temperature reached at Bakersfield was 97°F. Fresno reported a high of 98°F, slightly above normal.

Transport Winds

The surface winds from the tracer release site at Manteca are summarized below in Table 3.6.1. The surface flow was generally from the northwest during the release and for the remainder of the day. Wind speeds were unavailable from Manteca during this period. However, the winds were calm to the south at Modesto during the release and ranged from calm to 3 m/s at Stockton to the north.

Regional flows in the San Joaquin Valley during the test period have been determined from streamlines constructed from the 1000 ft pibal winds, and are shown in Figure 3.6.2 through 3.6.5. At the start of the tracer release (0900 PDT), an atypical flow from the southeast extended the length of the valley at 1000 ft, on the east side, diverging in the northern half of the valley. Wind speeds were uniform at 1-2 m/s across the north end of

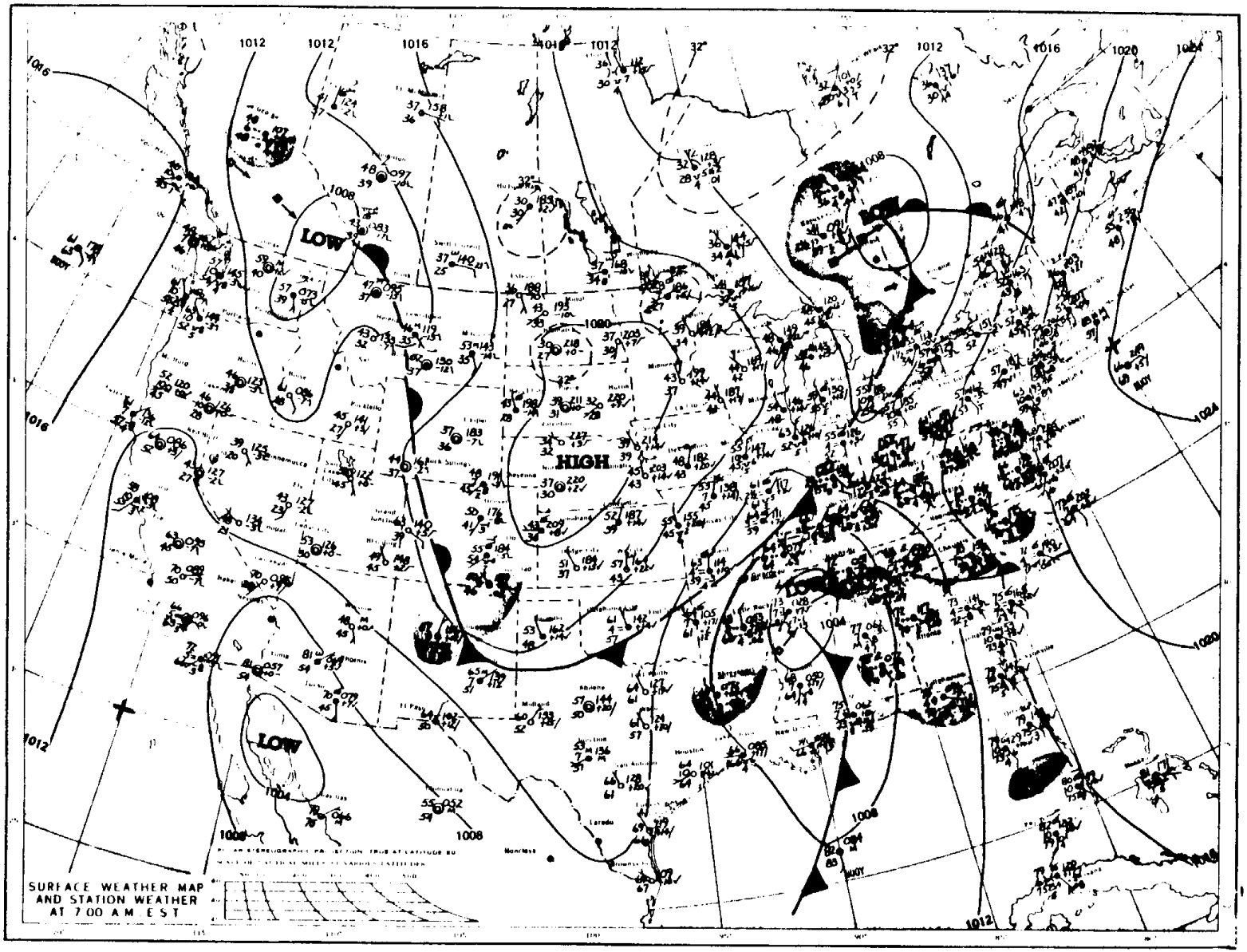


Figure 3.6.1· Surface Weather Chart - 21 September 1979 (05 PDT)

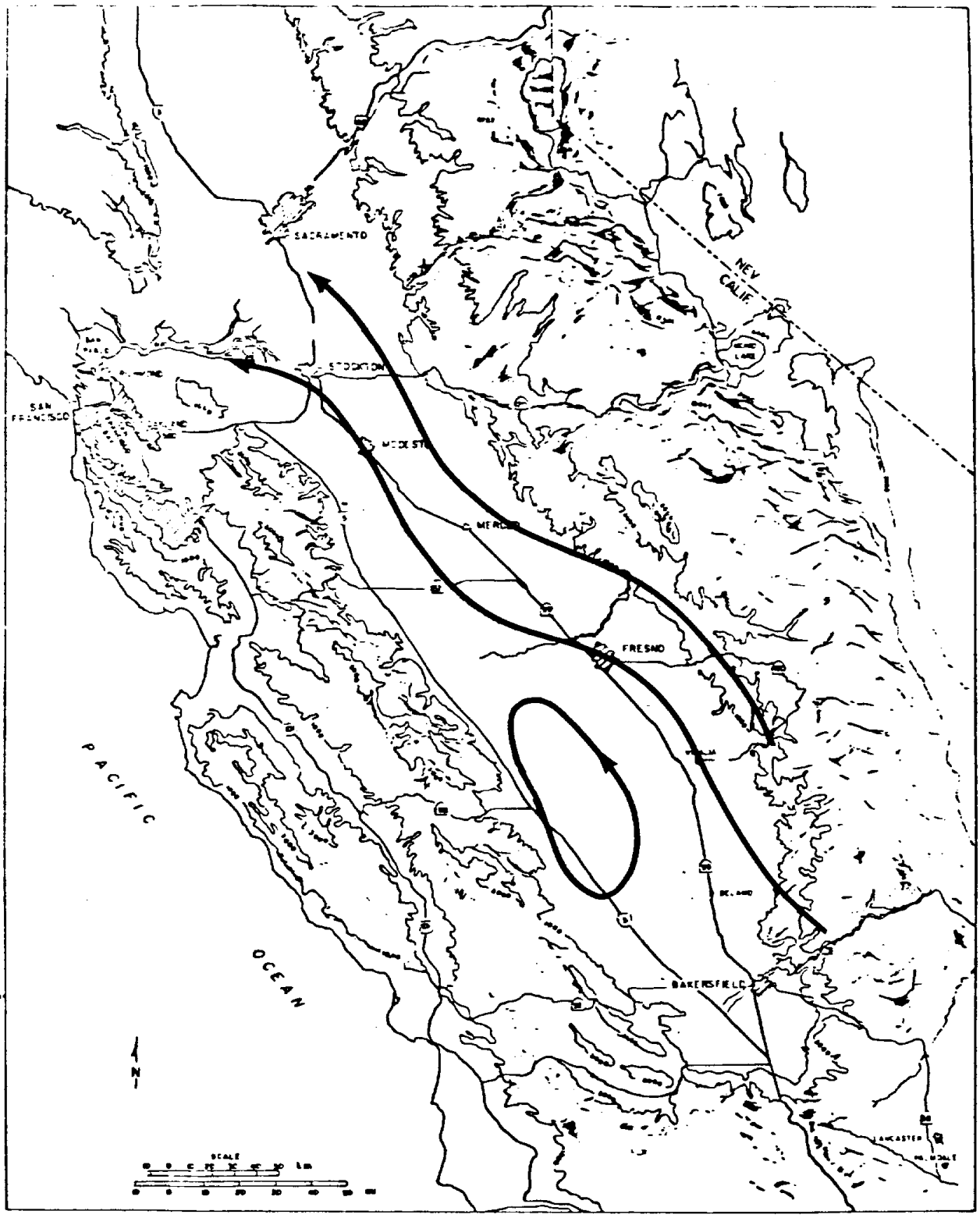


Figure 3.6.2 1000 Ft-agl Streamlines - 21 September 1979 (09 PDT)

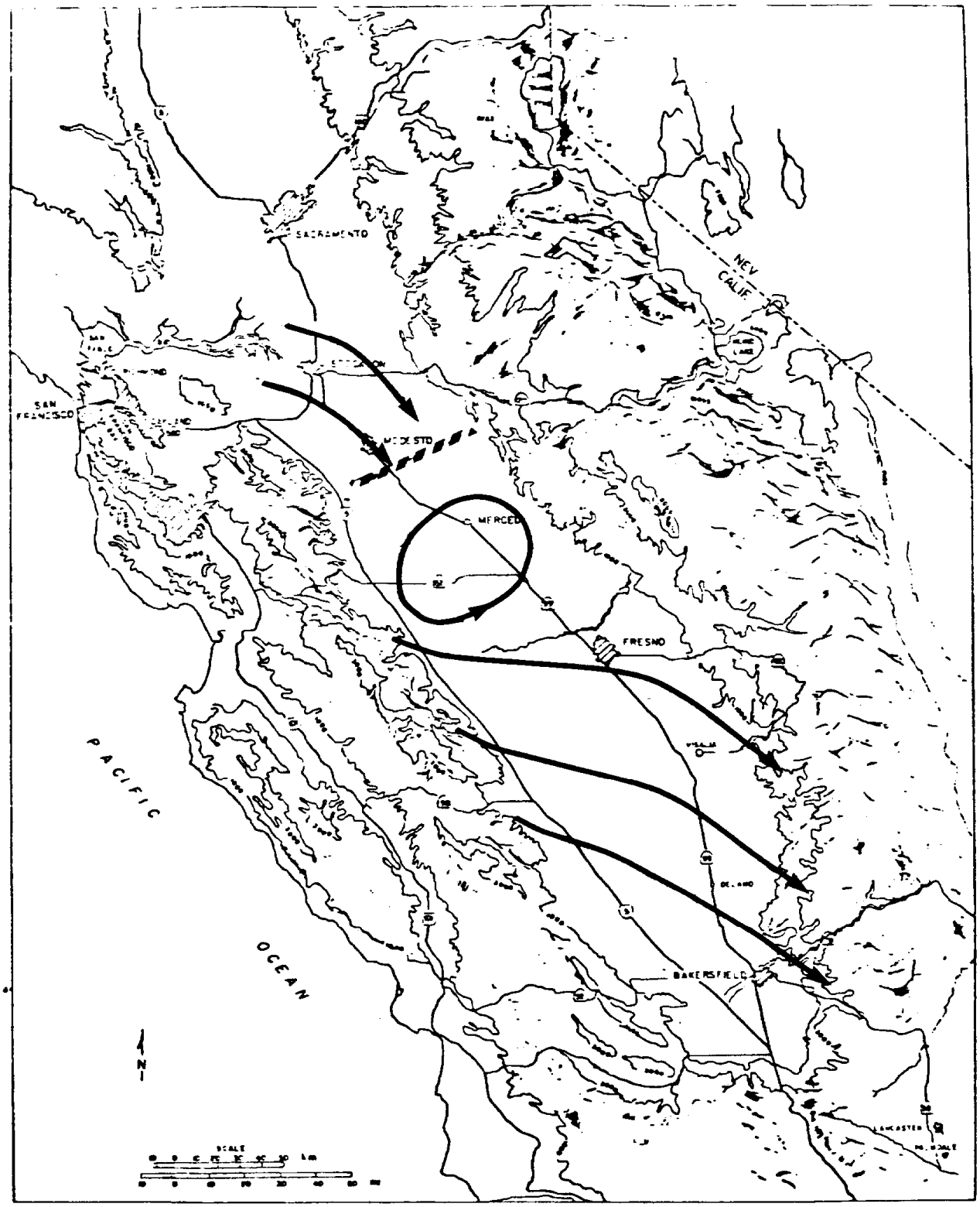


Figure 3.6.3 1000 Ft-agl Streamlines - 21 September 1979 (15 PDT)

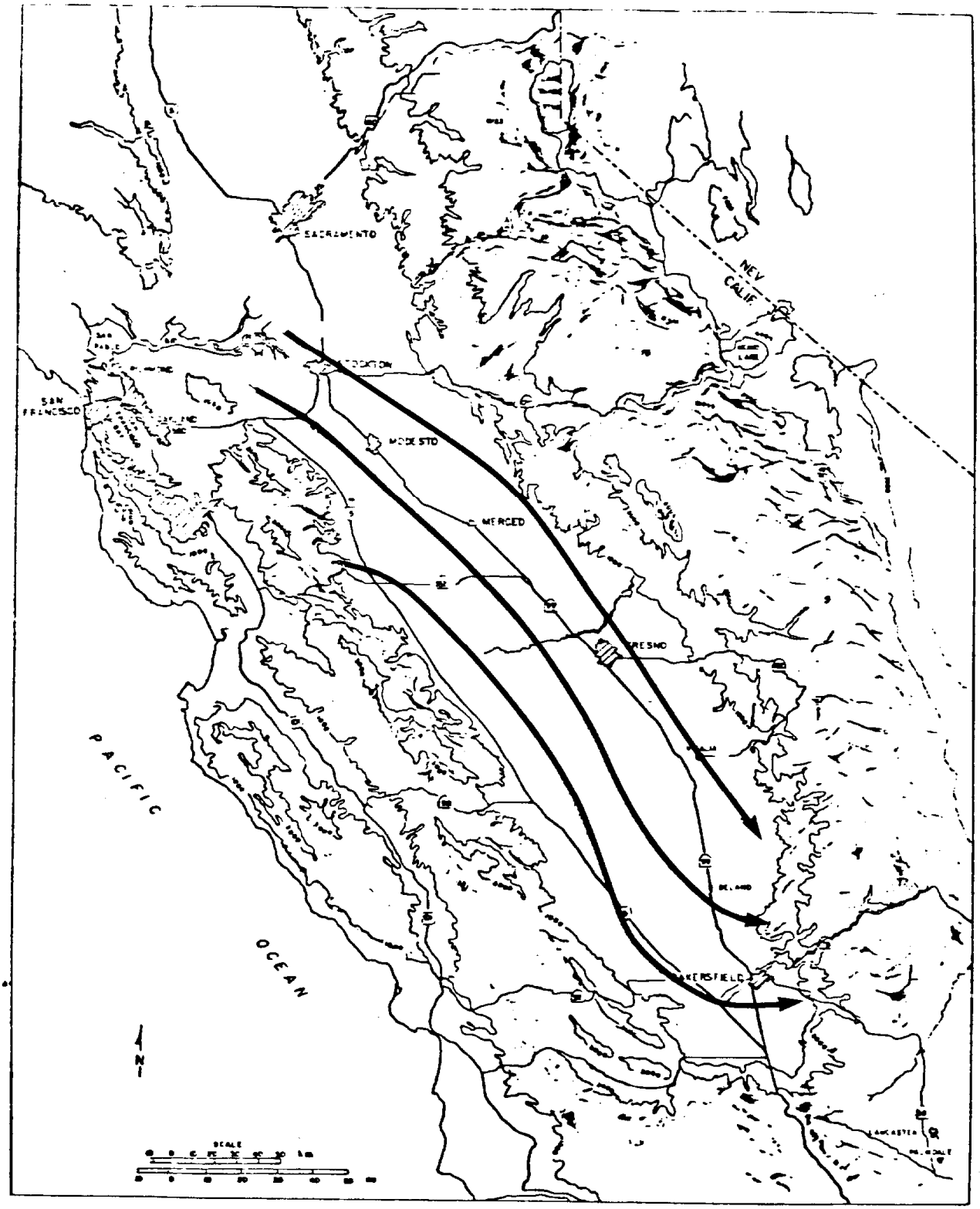


Figure 3.6.4 1000 Ft-agl Streamlines - 21 September 1979 (19 PDT)

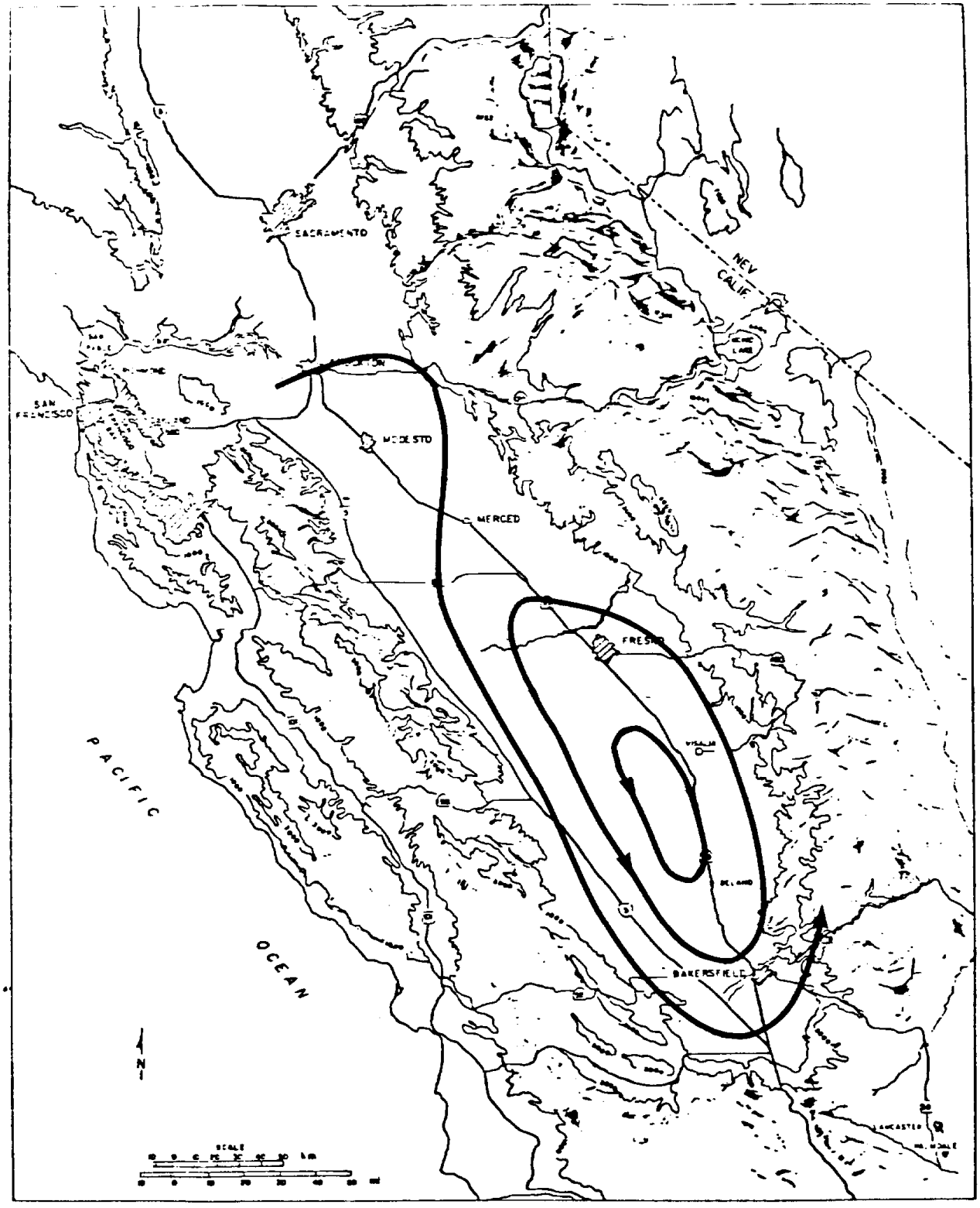


Figure 3.6.5 1000 Ft-agl Streamlines - 22 September 1979 (07 PDT)

Table 3.6.1

SURFACE WINDS FROM MANTECA
21 SEPTEMBER 1979

Time (PDT)	Wind Direction/Speed (m/s)
0900	015/missing
1000	340/ "
1100	320/ "
1200	350/ "
1300	300/ "
1400	270/ "
1500	340/ "

the valley until mid-afternoon. At 1500 PDT (Figure 3.6.3), the convergence zone between marine air intruding into the valley from the north and the flow within the valley had moved past Modesto Reservoir and to just north of Turlock. By the 1700 PDT observations, northwest winds dominated the flow throughout the valley and continued for the following several hours. The streamlines for 1900 PDT, shown on Figure 3.6.4 characterize the flow during this period. By midnight, an eddy induced by terrain constaints and atmospheric stabilization had formed in the south of the valley. The eddy continued to develop during the night, eventually dominating the flow in the valley south of Merced (Figure 3.6.5).

The vertical and temporal characteristics of the winds aloft can be examined with the time-height cross section of the winds from Turlock shown on Figure 3.6.6. The pibal winds have been resolved into components parallel and perpendicular to the valley axis. The parallel component was used to develop the cross section. As can be seen, flow into the valley did not begin until 1700 PDT but continued thereafter for the remainder of the test in the lower levels. Northwest winds, or a flux into the valley, did not extend any deeper than 1000 m at any time during the test. Flow with a southeast component persisted above. Within the northwest flow, a jet developed with speeds in excess of 8 m/s at about 2000 PDT on the 21st and continued until approximately 0300 PDT on the following morning.

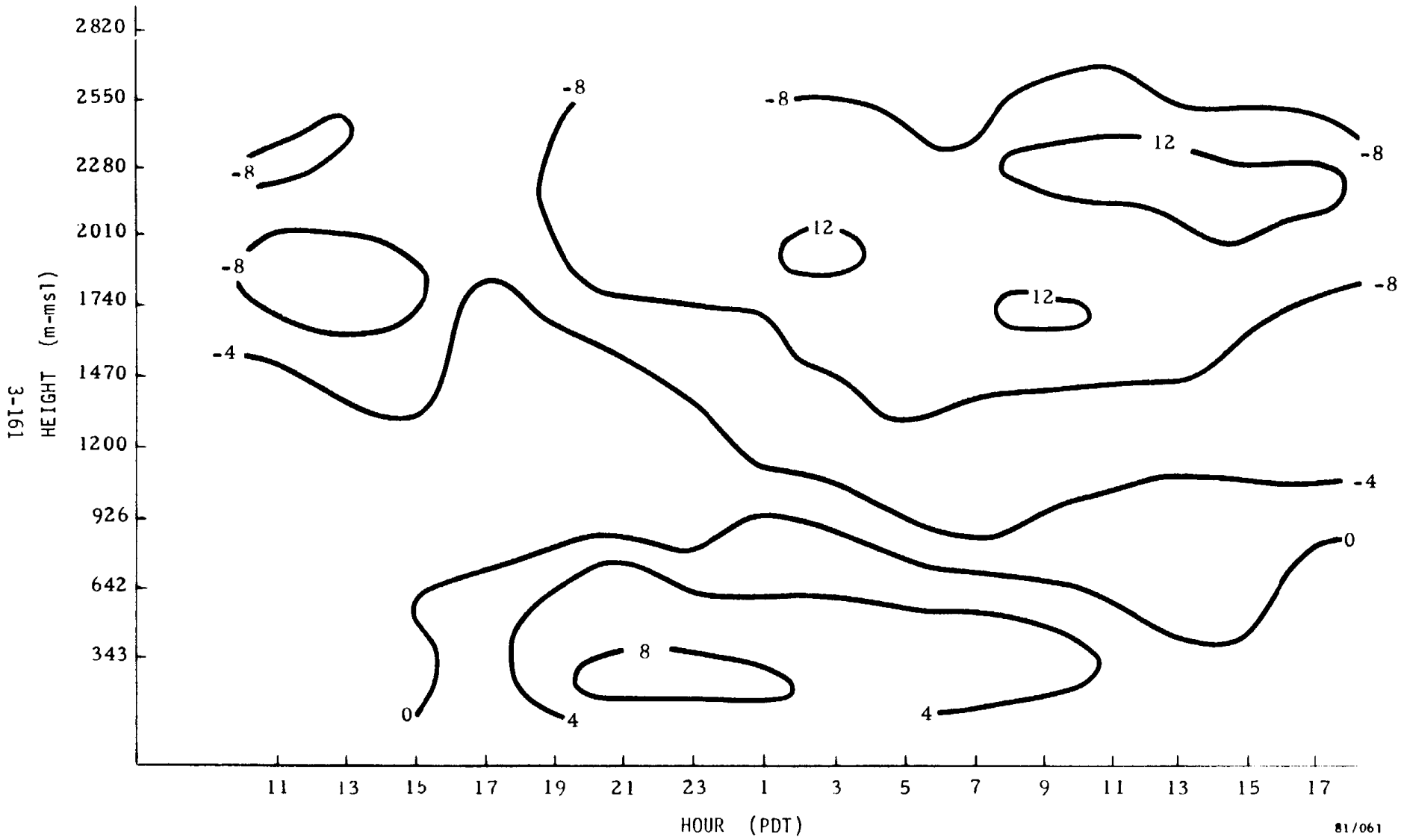


Figure 3.6.6 Time-Height Cross Section Component Winds (m/s) From Turlock - 21-22 September 1979

Mixing Heights

Mixing heights estimated from the aircraft observations on the 21st were 500-800 m. These heights are shown in Table 3.6.2. On the 22nd, slightly higher mixing depths were observed from pibal observations.

Table 3.6.2

AIRCRAFT MIXING HEIGHTS
September 21, 1979

Time (PDT)	Location *	Mixing Height (m [above ground level])
1727	Quinn	480
1803	Friant	790
1844	Fresno Airport	1000

(* Distances in miles)

3.6.2 Air Quality

Regional Pollutant Levels

Maximum hourly average ozone concentrations for 21 September are shown on Figure 3.6.7. Exceedances of California's air quality standard were experienced throughout the San Joaquin Valley and in the adjacent mountains. Maximum concentrations of .14 ppm were measured in the Fresno area.

Table 3.6.3 gives the maximum hourly concentrations of SO_2, CO and NO_x observed anywhere in the valley on September 21. Also shown are the maximum hourly values recorded at the Rockwell International vans. All pollutant concentrations were relatively low. The 850 mb temperatures continued to decrease, indicating less stable conditions.

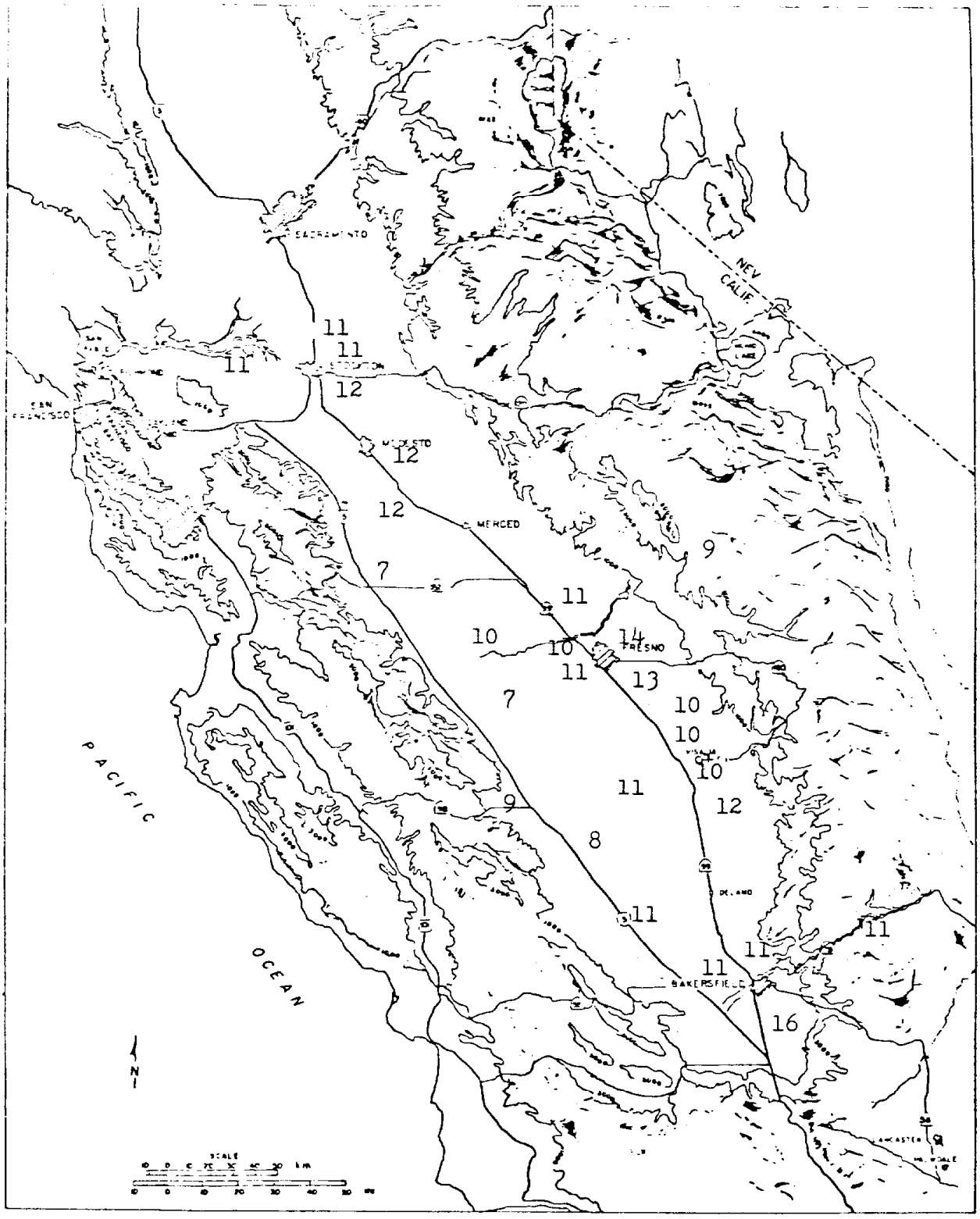


Figure 3.6.7 Maximum Hourly Ozone Concentrations (pphm) - 21 September 1979

Table 3.6.3

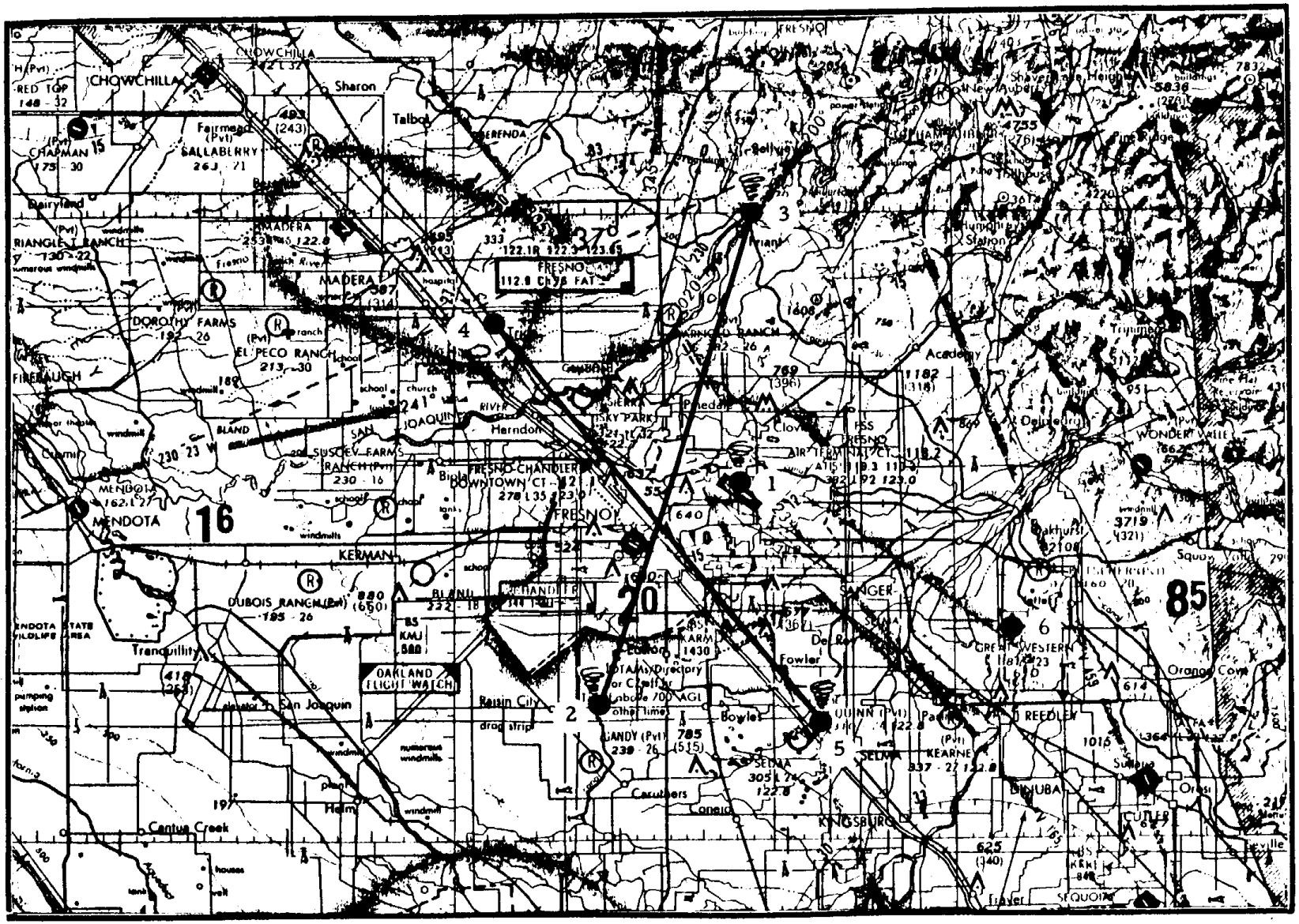
MAXIMUM HOURLY CONCENTRATIONS
SEPTEMBER 21, 1979

Parameter	Location	Maximum Value (ppm)
SO_2	Bakersfield	.03
CO	Five Points	1
CO	Fresno (all)	1
CO	Shaver Lake	1
CO	Bakersfield	1
CO	Modesto	1
CO	Visalia	1
NO_x	Bakersfield	.39
SO_2	Arvin (RI)	.01
SO_2	Lost Hills (RI)	.01
SO_2	Reedley (RI)	.01
NO_x	Arvin (RI)	.02
NO_x	Lost Hills (RI)	.05
NO_x	Reedley (RI)	.04

Aircraft Sampling

The MRI aircraft sampled the Fresno urban plume late on the afternoon of the 21st. Surface winds were light and variable through 1700 PDT becoming west to northwest at speeds less than five knots thereafter. Winds aloft below 2000 ft were generally light and from the south until about 1500 PDT when they began to veer westerly. The mixing depths ranged from 520 m in the Fresno area to 900 m over Friant near the Sierra foothills. Figure 3.6.8 shows the aircraft sampling route. Table 3.6.4 summarizes the pollutant characteristics observed. Figures 3.6.9 to 3.6.11 show the soundings made during the flight.

Due to the light and variable nature of the winds, the Fresno urban plume was characterized as a broad NO_x and O_3 plume extending to the north and east as far as Friant (1747 PDT) and extending south along the Sierra foothills to near the mouth of the Kings Canyon (1820 PDT). Peak ozone levels of .20 ppm were measured along this traverse, approximately 14 nm east of downtown Fresno.



SAMPLING ROUTES 21 SEPTEMBER 1979

Figure 3.6.8

Table 3.6.4

AIR QUALITY MEASUREMENTS CARB SAN JOAQUIN VALLEY PROJECT
SEPTEMBER 21, 1979 SAMPLING

Start Time (PDT)	Location (Point)	O_3		b_{scat}		SO_2		NO_x		NO	
		Mean (ppb)	Max (ppb)	Mean ($x10^{-6}m^{-1}$)	Max	Mean (ppb)	Max (ppb)	Mean (ppb)	Max (ppb)	Mean (ppb)	Max (ppb)
1711	4-5	160	184	181	262	-	-	21	61	-	-
1728	5	118	171	120	228	-	-	9	34	-	-
1747	2-3	172	188	185	248	-	-	17	36	-	-
1803	3	149	192	134	232	-	-	11	24	-	-
1820	3-6	157	204	154	248	-	-	15	29	-	-
1844	1	121	175	137	266	-	-	13	43	3	11

The sounding in Figure 3.6.9 (1727 PDT) was made over Quinn Airport just west of Reedley. Ozone levels to .17 ppm were observed in the mixed layer. A strong CN plume was apparent, centered at a level of 360 m (msl).

The data in Figure 3.6.10 were taken near Friant at 1803 PDT. A well-mixed layer to 600 m (above ground level) was apparent, characterized by ozone levels to .18 ppm.

A sounding was made at the Fresno Airport at 1844 PDT (Figure 3.6.11). The mixed layer extended to 630 m (msl) and contained maximum ozone levels of .17 ppm. Ozone concentrations above the mixed layer were about the same (.10 to .12 ppm) as observed in the previous soundings.

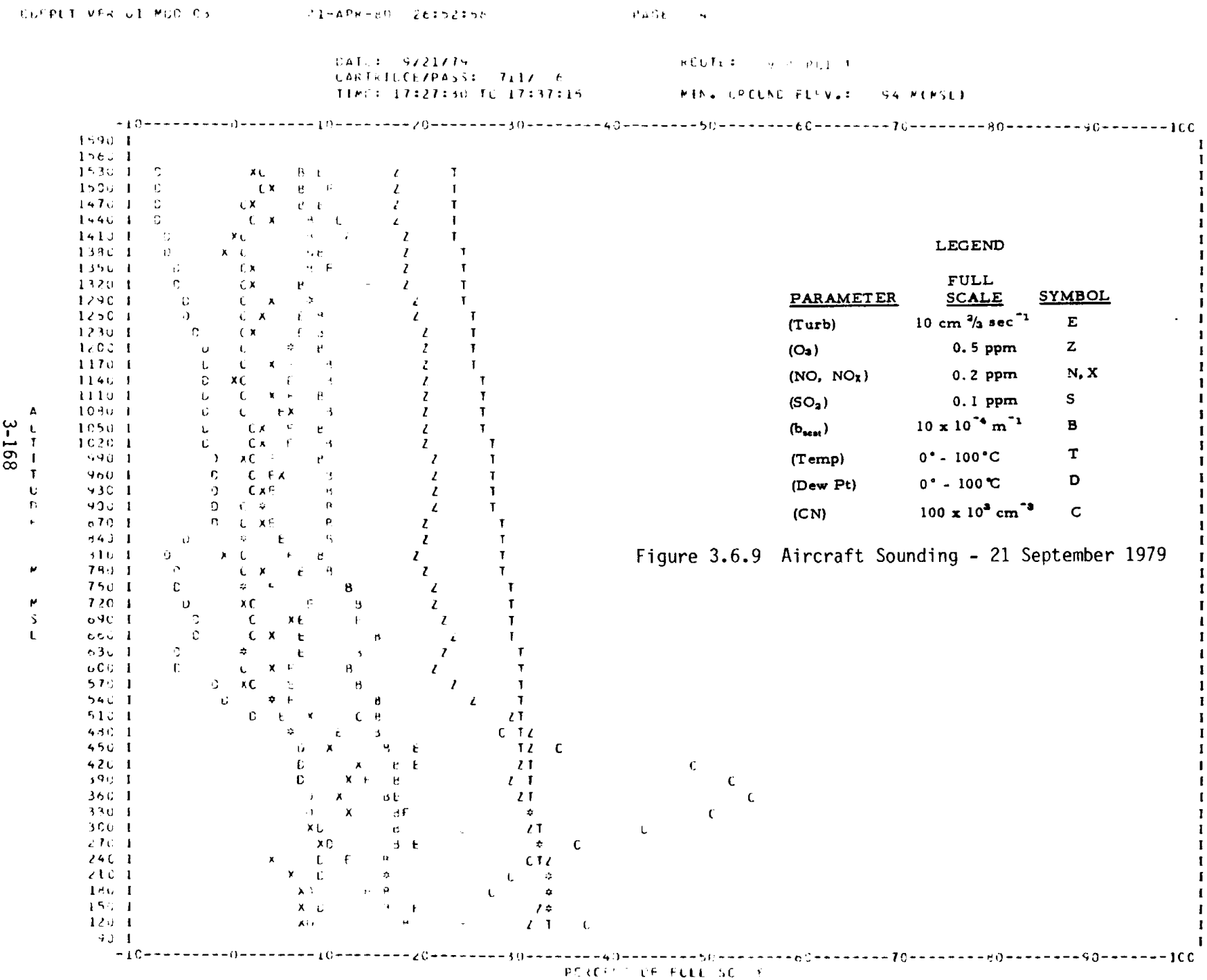
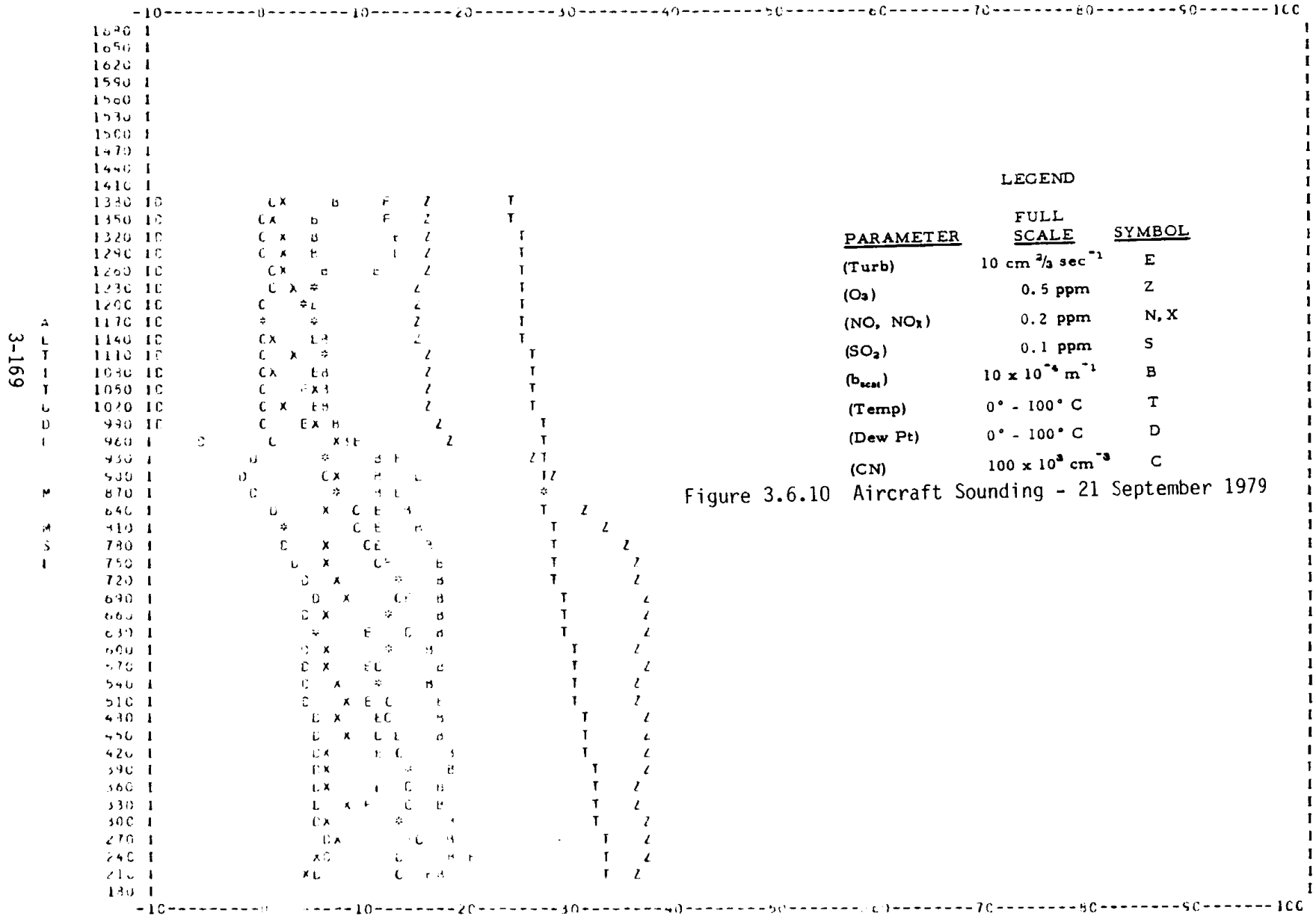


Figure 3.6.9 Aircraft Sounding - 21 September 1979

DAT : 9/21/79
CARTRIDGE/PASS: 7117 8
TIME: 18: 3:15 TO 18:13: 9

ROUTE: [illegible] POINT 2
MIN. GROUND ELEV.: 173 M(MSL)

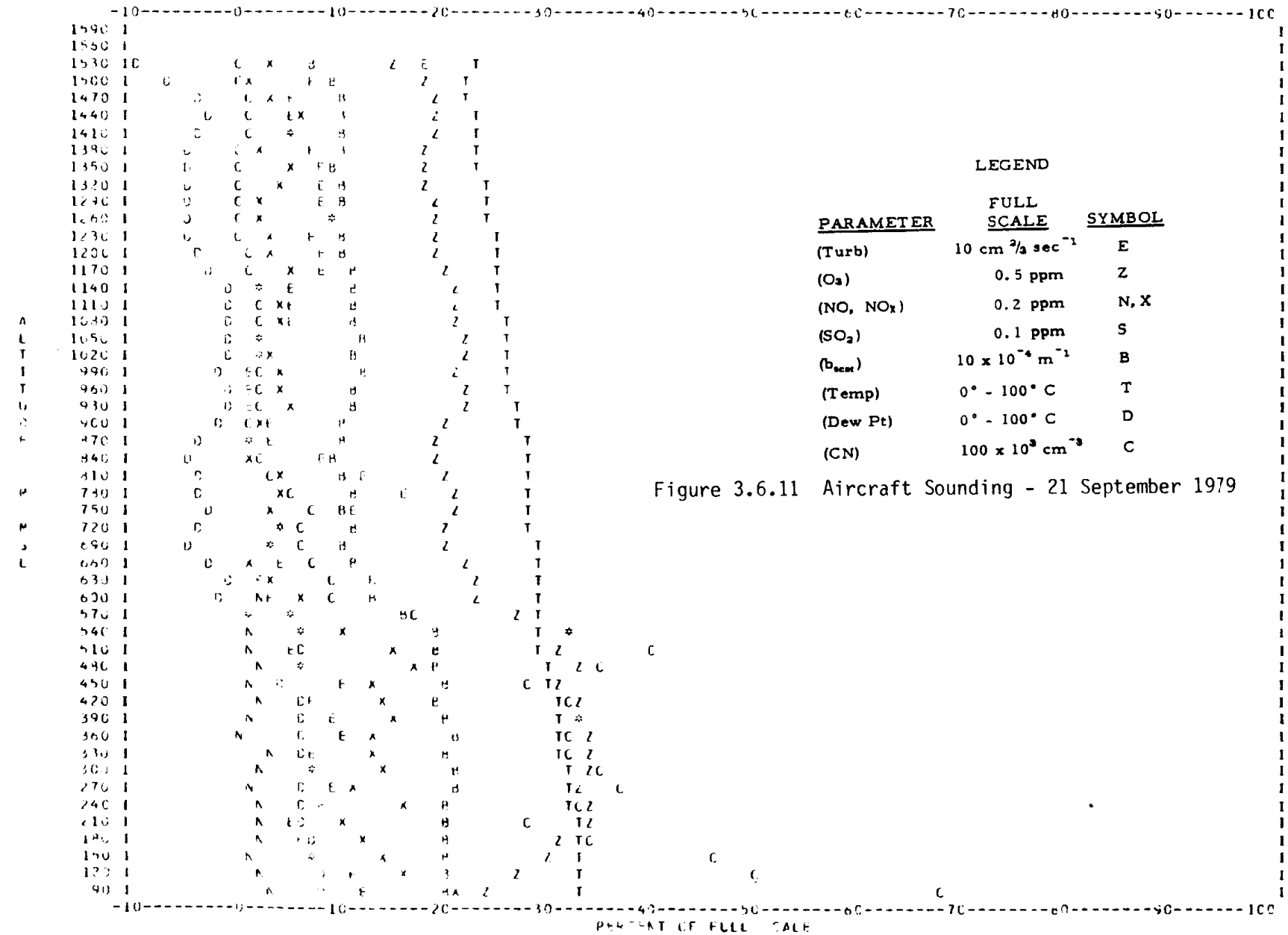


LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec $^{-1}$	E
(O_3)	0.5 ppm	Z
(NO, NO_X)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100° C	T
(Dew Pt)	0° - 100° C	D
(CN)	100 x 10^3 cm^{-3}	C

Figure 3.6.10 Aircraft Sounding - 21 September 1979

DATE: 9/21/79 ROUTE: [illegible]
CARTRIDGE/PASS: 7117 10
TIME: 18:44:14 TO 18:53:55 MIN. GROUND ELEV.: 100 M(MSL)



LEGEND

PARAMETER	FULL SCALE	SYMBOL
(Turb)	10 cm $^{2/3}$ sec $^{-1}$	E
(O_3)	0.5 ppm	Z
(NO, NO_x)	0.2 ppm	N, X
(SO_2)	0.1 ppm	S
(b_{scat})	10 x 10^{-4} m^{-1}	B
(Temp)	0° - 100° C	T
(Dew Pt)	0° - 100° C	D
(CN)	100 x 10^3 cm^{-3}	C

Figure 3.6.11 Aircraft Sounding - 21 September 1979

3.6.3 Tracer Test 6

Release Location: Manteca, San Joaquin County
Time and Date: 0900-1400 PDT, 9/21/79
Release Amount: 97 lbs SF6/hr
Release conducted during light and variable winds. The predominant flow was from the northwest at speeds up to about 3 mps.

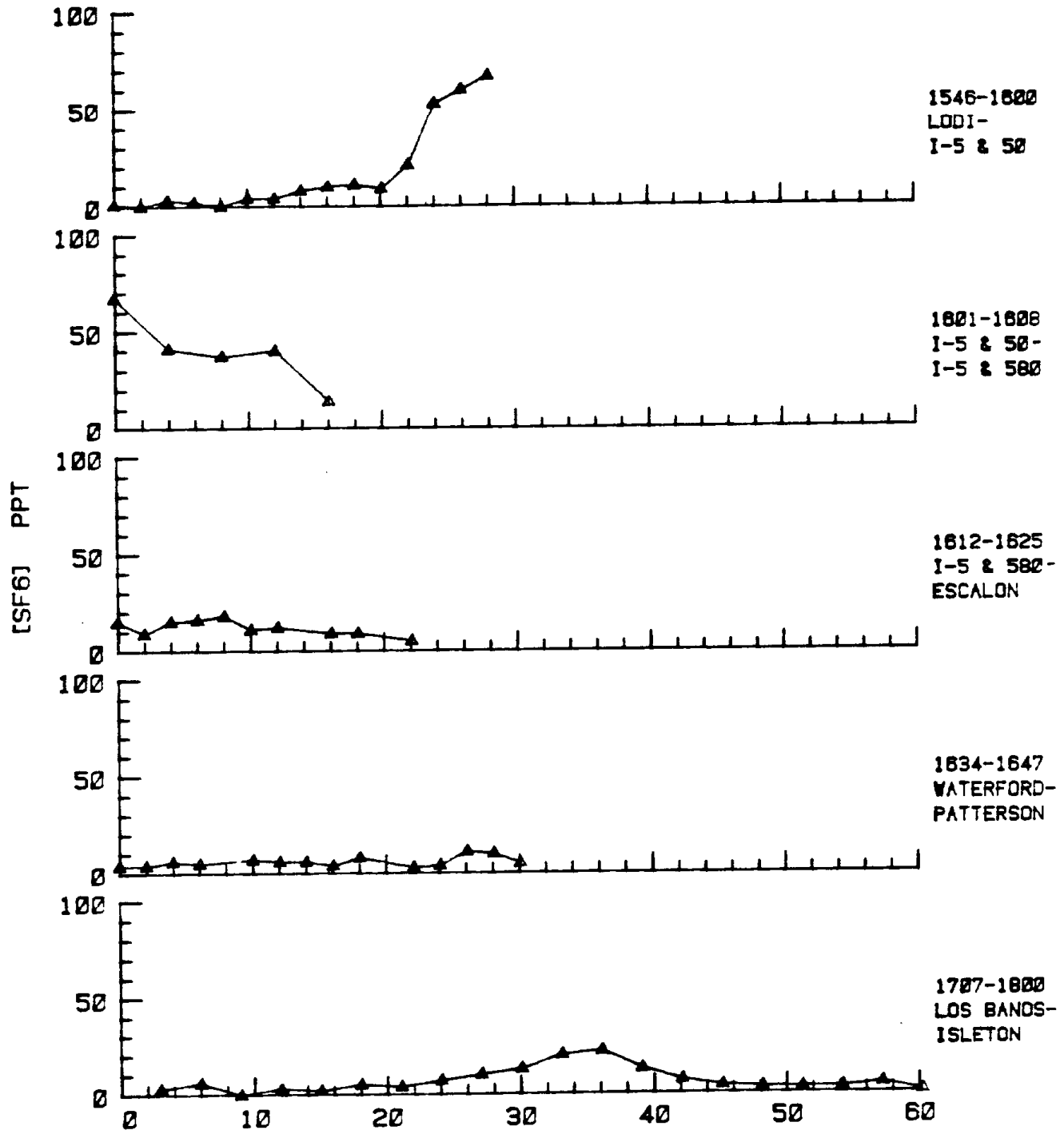
Detection of SF6 west of Manteca prior to release

Between 1546 and 1600 PDT on 9/20/79, an airplane traverse was conducted at the northern mouth of the San Joaquin Valley. The SF6 concentrations detected during this traverse are shown in Figure 3.6.12. Significant concentrations of the tracer were detected at the extreme western edge of the valley. The tracer detected in this area was due to a release of SF6 by the Pacific Gas and Electric Company during their investigation of the transport and dispersion of an elevated stack gas plume from the California Delta region. Clearly, a significant fraction of the tracer released with the stack gases was transported into the western edge of the San Joaquin Valley.

Transport of tracer released on 9/21/79

Initial transport southward

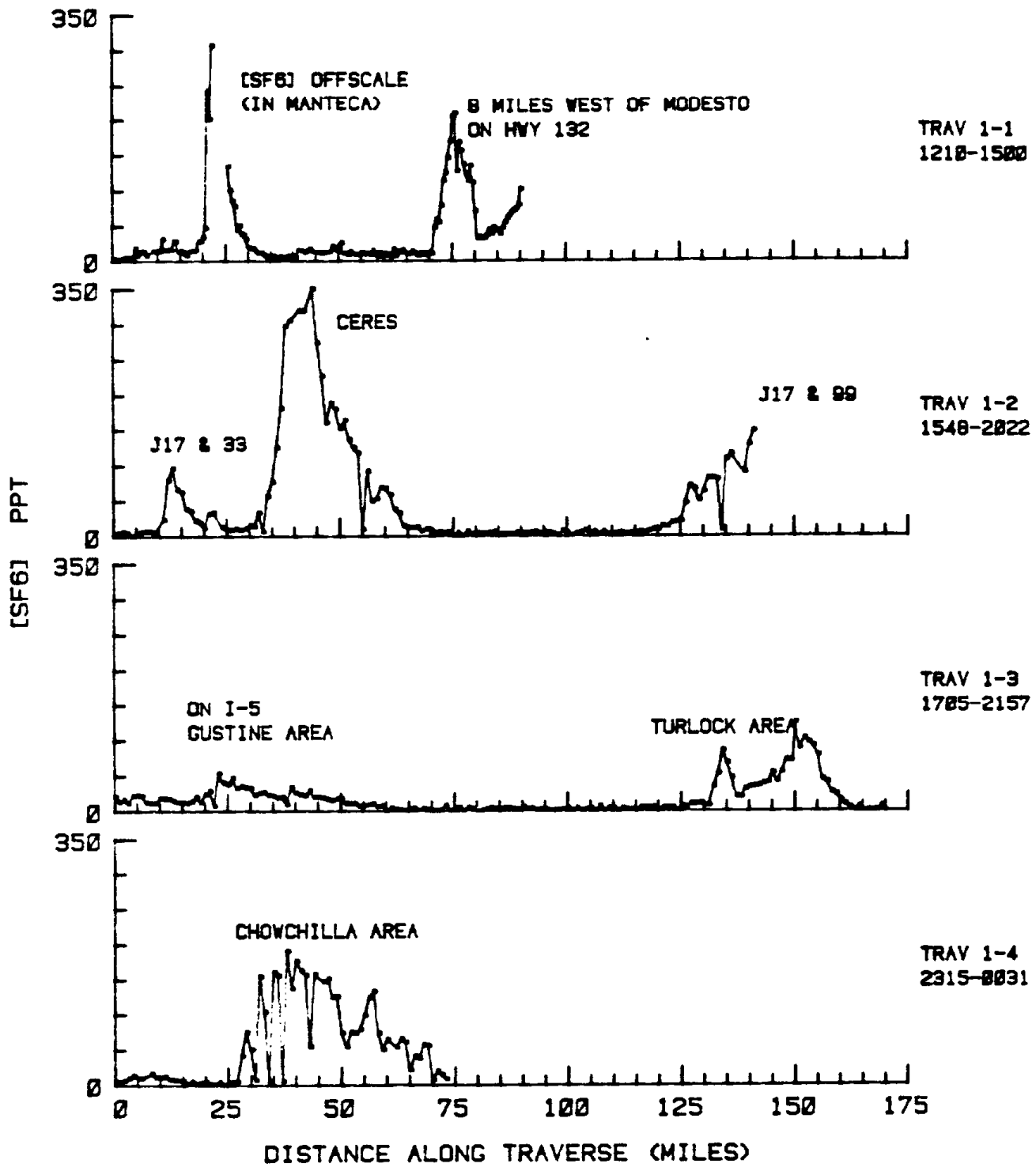
As shown in Figure 3.6.13, high concentrations of the tracer released during this experiment were detected south of Manteca. The highest tracer concentrations (as high as 360 PPT or 540 PPT/lb-mole released/hr) were detected near Modesto during Traverses 1-1 and 1-2 conducted during the mid afternoon on the day of the release. A plume of lower concentration was detected on the extreme western side of the valley during Traverses 1-2 and 1-3. This smaller plume may be the result of the variable wind conditons that existed at the beginning of the release.



TRAVERSE ROUTE: AS NOTED, 1500' ABOVE MSL

RELEASE LOCATION: 485 # SF6 AT MANTECA
RELEASE TIME: 0900-1400 PDT, 9/21/79

Figure 3.6.12



RELEASE LOCATION: 485 # SF6 AT MANTECA
RELEASE TIME: 0900-1400 PDT, 9/21/79

Figure 3.6.13

Continued transport along HWY 99

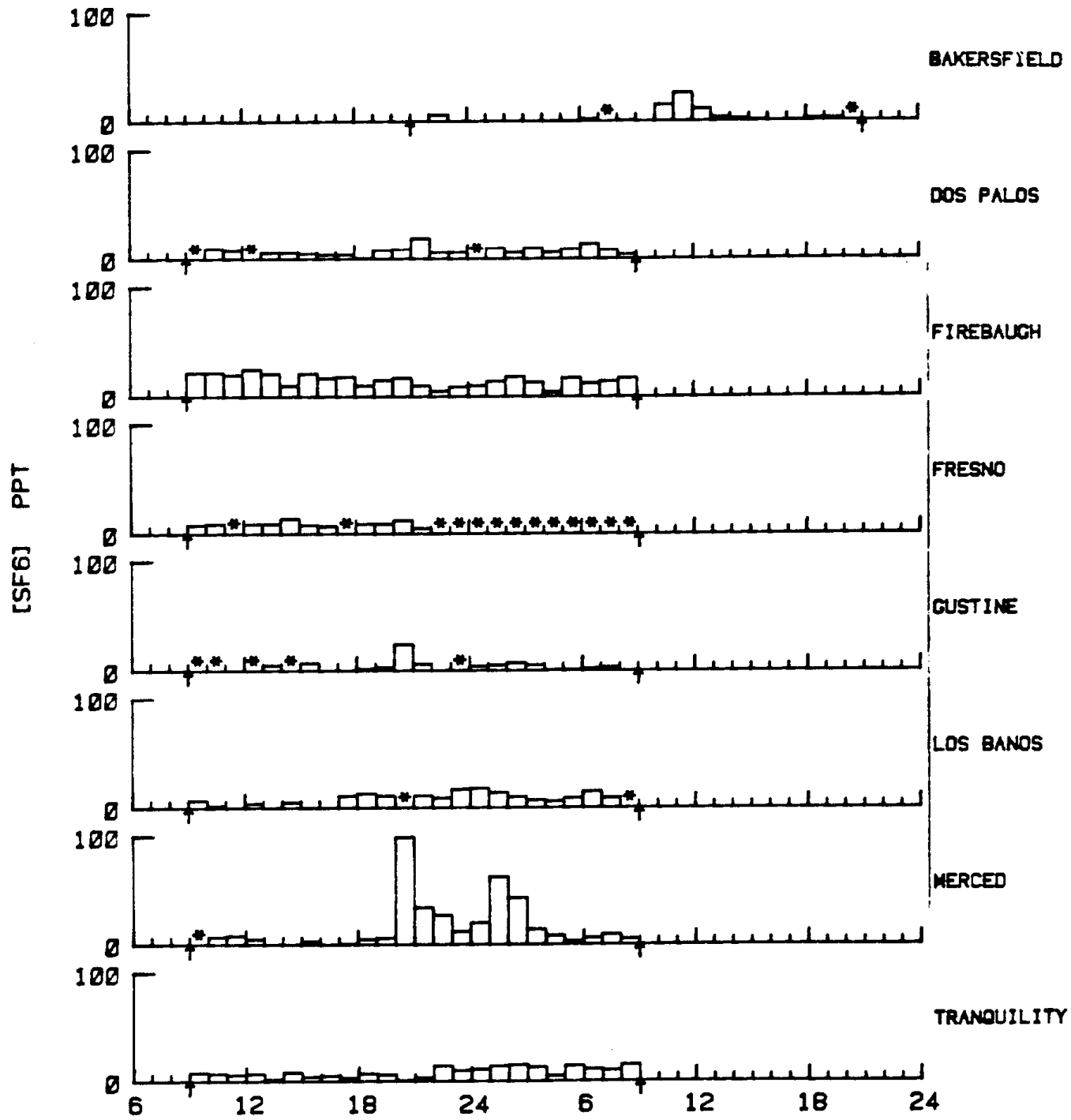
As the afternoon progressed, the tracer was detected at locations further and further south. The highest concentrations continued to be detected along Hwy 99. As shown in Figure 3.6.14, SF6 was first detected at Merced between 2000 and 2100 PDT. About 100 PPT (150 PPT/lb-mole released/hr) were detected at Merced at this time. After 2100 PDT, the tracer concentration at Merced decreased to a low of 12 PPT before rapidly increasing to a maximum of about 60 PPT, detected between 0100 and 0200 PDT. Judging from the surface winds on the eastern side of the valley, the detection of a second SF6 peak at Merced corresponds to the development of a southeasterly wind that apparently transported some of the tracer back towards Merced. At Visalia the afternoon and evening northwesterly wind had shifted to southeasterly by 0100 PDT. By 0500 PDT, the southeasterly wind had progressed as far north as Stockton.

Transport to extreme southern end of valley

Throughout the night following the release the winds on the western side of the valley were northwesterly. Surface layer wind speeds at Los Banos ranged from almost 10 mps at 1900 PDT to about 3 mps at 0700 on the morning following the release. Apparently due to the northwesterly winds in the western part of the valley, SF6 was transported as far south as Bakersfield by 1000 PDT, 9/22/79, about 25 hours after the start of the release. This corresponds to a net transport speed of about 10 miles per hour.

Carryover into day following release

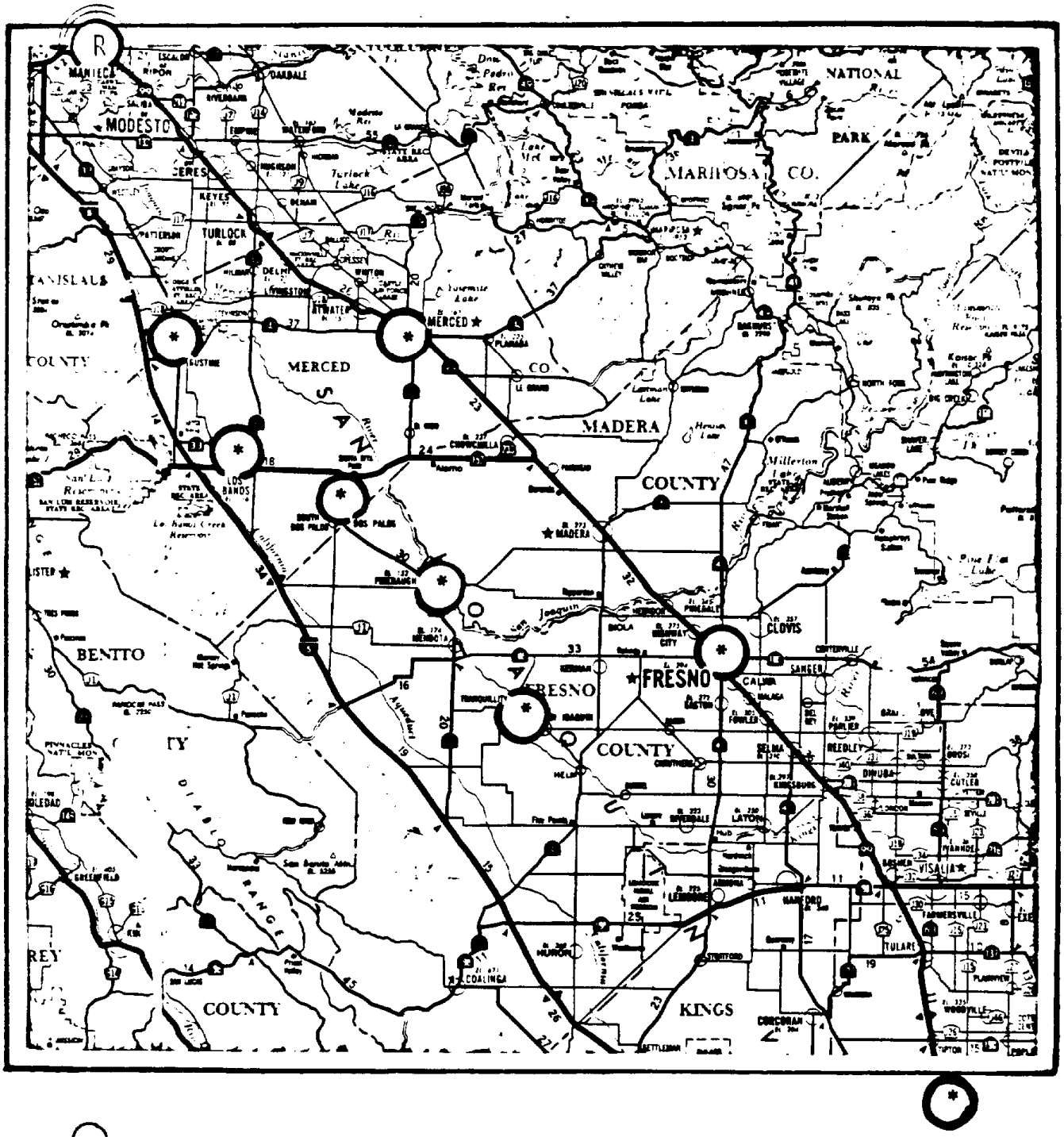
Judging from the tracer concentrations detected at Merced during the early morning, most of the released tracer was still on the east-central part of the San Joaquin Valley by mid-day on the day following the release. This tracer dispersed rapidly during the unstable afternoon conditions and only low, but non-zero tracer concentrations could be detected throughout the afternoon of 9/22/79. The tracer appeared to be well-mixed over a large part of the San Joaquin Valley at essentially uniform background concentrations (5-10 PPT). Higher levels (10-20 PPT) were, however, detected in the vicinity of Fresno.



RELEASE: 97 # SF6/HR AT MANTECA
RELEASE TIME: 0900-1400 PDT, 9/21/79

* INDICATES MISSING DATA
ARROWS INDICATE BOUNDS OF SAMPLING PERIOD

Figure 3.6.14



⊙ INDICATES SAMPLER LOCATIONS

Ⓡ IS THE RELEASE SITE

Figure 3.6.15

Also, automobile traverses heading along I-5 found low, but again, non-zero, tracer concentrations in and around the Los Angeles Basin. As shown in Figure 3.6.16, a high of 8 PPT was detected in Burbank on the evening of 9/22/79 and similar concentrations were found near Newhall around midnight of 9/22/79. The source of these low tracer concentrations may be either the PG&E experiment conducted before the current test, or some of the tracer earlier detected at Bakersfield from the current release of SF6 from Manteca.

Summary

On the day before the release of the tracer, SF6 was detected on the extreme western edge of the San Joaquin Valley. This SF6 was released from the California Delta region by Pacific Gas & Electric Co. during an investigation of the transport and dispersion of a bouyant stack gas plume. The tracer was apparently transported through the mouth and down the western side of the valley.

During this experiment, i.e. the experiment conducted by the authors, the tracer was released from Manteca. As in the previous Manteca releases conducted during July, the tracer was generally transported southward by the afternoon northwesterly winds. An overview of the tracer transport path can be found in Figure 3.6.17. During this experiment the maximum impact of the tracer was along Hwy 99 rather than on the western side of the valley as during the previous Manteca releases. Some of the tracer was detected on the western side of the valley, however, and this material was apparently transported by consistent northwesterly winds to Bakersfield by about 25 hours after the start of the release. The bulk of the material, however, was apparently still in the vicinity of Fresno during the afternoon on the day following the release. Only low concentrations of tracer could be detected on the afternoon following the release indicating that unstable afternoon conditions led to efficient dispersion of the tracer.

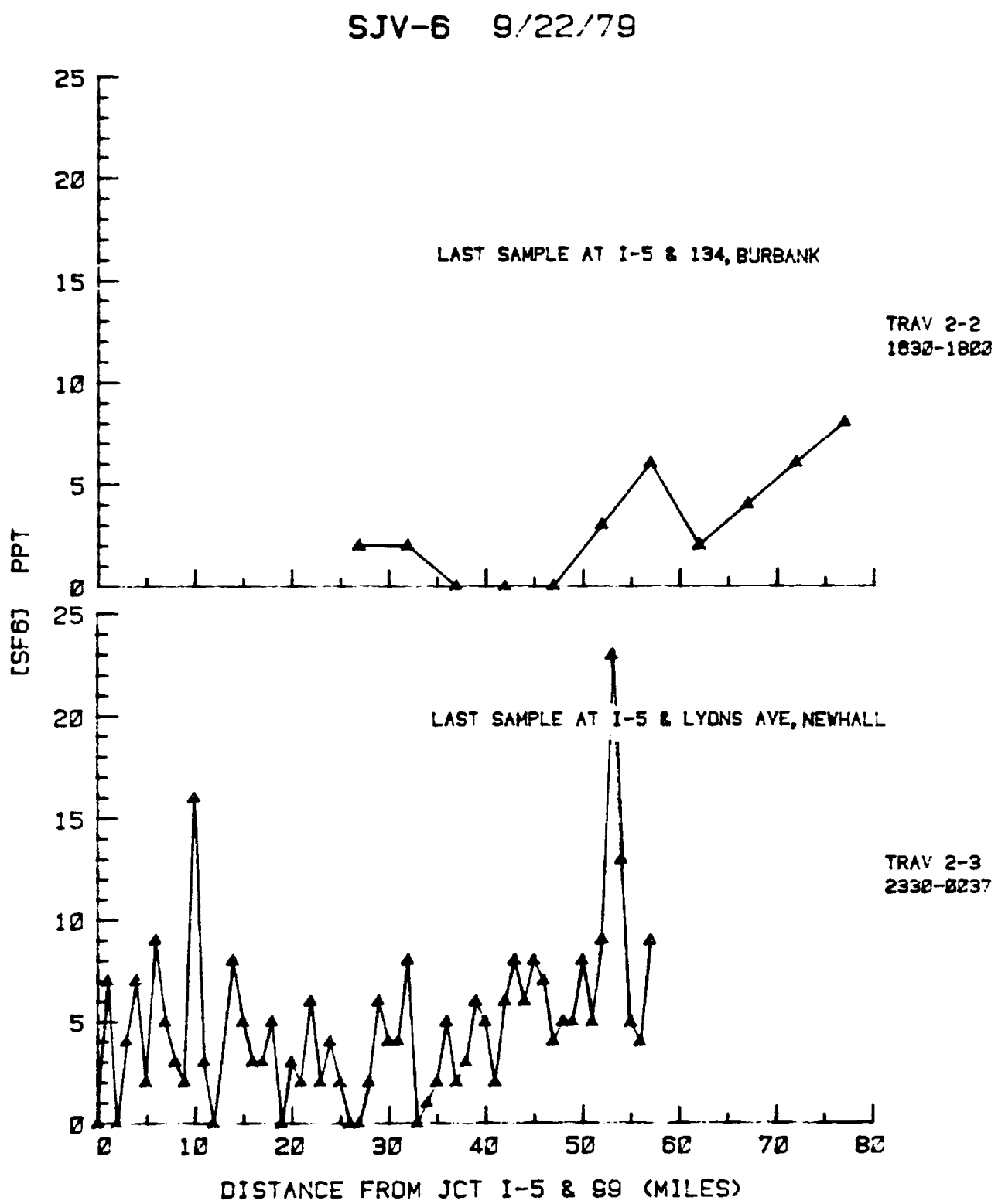
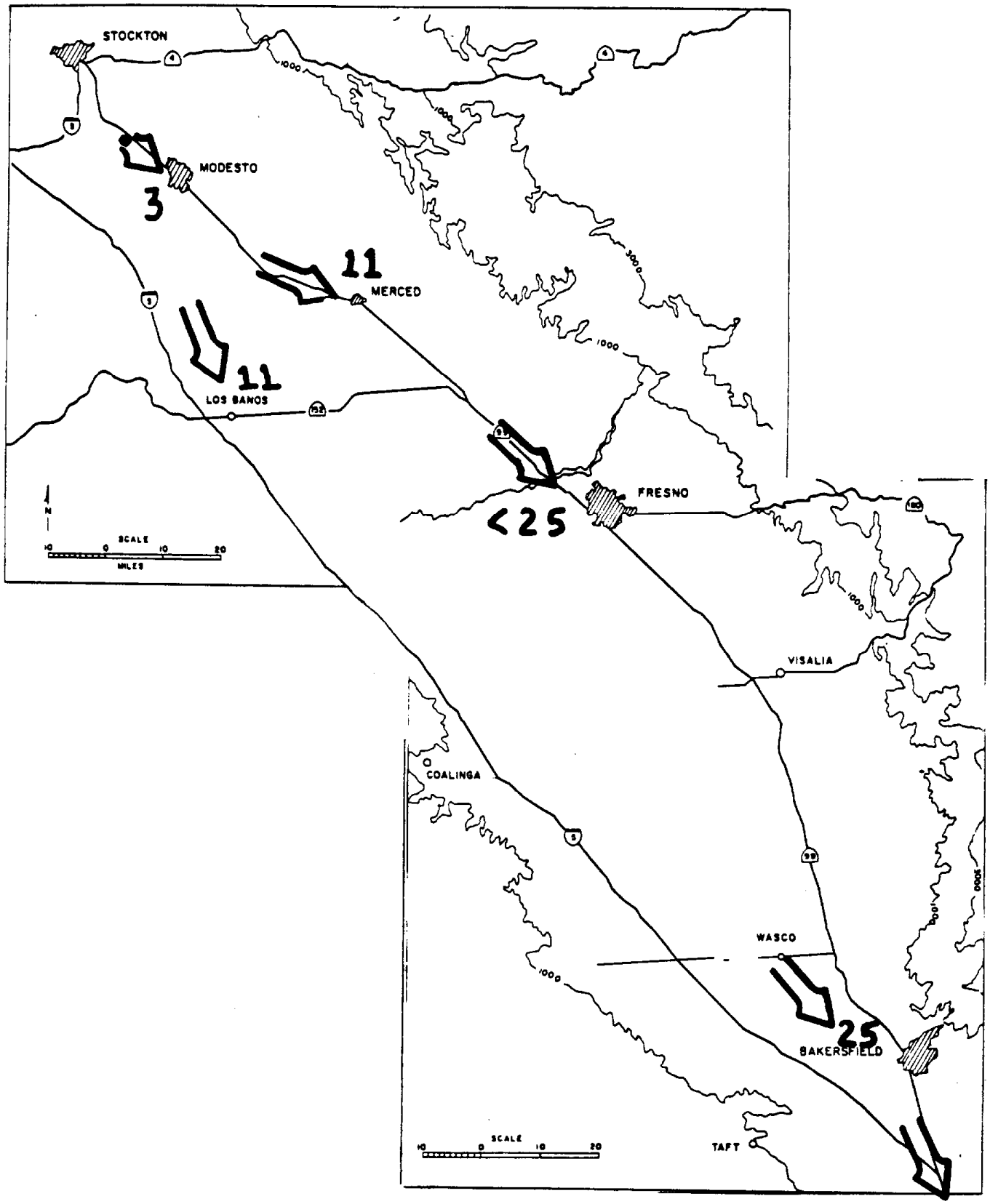

SJV-6 9/22/79
LAST SAMPLE AT I-5 & 134, BURBANK
TRAV 2-2
1830-1800
LAST SAMPLE AT I-5 & LYONS AVE, NEWHALL
TRAV 2-3
2330-0037
[SF6] PPT
DISTANCE FROM JCT I-5 & 99 (MILES)
TRAVERSE ROUTE: SOUTH ON I-5
RELEASE LOCATION: 485 # SF6 AT MANTECA
RELEASE TIME: 0900-1200 PDT, 9/21/79

Figure 3.6.16



RELEASE SITE - MANTECA
ARROW POINT INDICATES OBSERVED TRACER LOCATIONS
NUMBERS REFER TO HOURS AFTER RELEASE START (0900 PDT, 9/21/79)

Figure 3.6.17

4. Conclusions

1. The September 1979 field program was characterized by warmer than average temperatures at 850 mb. All tracer tests were carried out under these conditions.
2. Average wind flow at Stockton and Los Banos was directed into the valley (Stockton to Bakersfield) at all hours of the day. This flow is driven primarily by a surface pressure gradient between the coastal and inland areas.
3. Average winds at Fresno, Visalia and Bakersfield reflected the development and northward spread of the Fresno Eddy during the night and early morning hours.
4. The eddy develops to an average depth of about 1200 m. Some of the northwesterly flow approaching the eddy is carried aloft, over the eddy to an altitude where the air can pass out of the valley to the southeast. The eddy developed on 17 of 22 nights during the program.
5. The nocturnal wind jet formed on most of the nights during the September field program (14 of 22 for strong jet conditions). Peak wind speed was about 300-400 m and occurred between 21 and 23 PDT.
6. Mixing layer heights during mid-afternoon ranged from 600 to 1200 m for the tracer release days.
7. Maximum ozone concentrations observed on tracer test days were .12 to .17 ppm with Arvin frequently recording the highest values within the valley.
8. Maximum CO concentrations ranged from 1 to 6 ppm with NO_x values of .17 to .39 ppm on tracer test days.
9. NMHC concentrations averaged about .3 ppm at Arvin and 2.9 ppm at Lost Hills. Reactive components, however, were quite low.

10. The contribution to total particle composition from fugitive emissions increased substantially compared to the winter intensive period. Sources of ammonium sulfate and carbon also contributed significantly.

11. Tracer released between 0700 and 1200 PDT on September 5, 1979 at Oildale was initially transported by a southeasterly drainage wind towards Shafter. At about 1000-1100 PDT, the afternoon northwesterly winds began to develop reversing the transport direction of the previously released tracer. The wind reversal mixed the tracer over a wide area with measurable impacts being noted in Mettler and Lake Isabella as well as east and southeast of the release site. About 85 percent of the tracer was transported into the Mojave Desert by the evening following the release. The timing of the arrival of SF_6 in the Mojave Desert indicated that the southern San Joaquin Valley is the source of aerosol particles that typically reduce visibility from 100 miles or more during the day to less than 50 miles at night at the China Lake Naval Weapons Center in the desert.

12. Tracer released between 0200 and 0700 PDT on September 8, 1979 at Oildale was initially transported towards the northwest as in the previous test. Also as in the previous test, the typical afternoon northwesterly flow reversed the transport direction and led to a widespread impact of the tracer in the southeastern San Joaquin Valley. The impact upon the Mojave Desert was also very similar to the previous test. The earlier release time apparently contributed only to spreading the tracer more uniformly throughout the impact zone.

13. Tracer released between 0700 and 1200 PDT on September 11, 1979 at Fellows was transported upslope by easterly winds. Essentially no significant tracer concentrations were detected within the San Joaquin Valley as a result of this test. The convergence of an easterly flow on the western side of the valley and westerly flow (typically) from the coastal areas, apparently transported the tracer aloft, thus minimizing the ground level impact of the tracer within the San Joaquin Valley.

14. Tracer released between 0107 and 0647 PDT on September 14, 1979 from Fellows was transported by the early morning southwesterly winds. Typically nighttime drainage conditions lead to the development of a flow convergence near the center of the San Joaquin Valley. During this experiment, however, the tracer was efficiently transported through the predicted convergence zone and detected at Bakersfield and Oildale within about 10 hours after the beginning of the release. Clearly, the structure of the nighttime convergence zone is such that it may not pose an effective barrier to transport. After the onset of the daytime upslope flow patterns, the tracer was transported into the Tehachapi Mountains and presumably into the Mojave Desert.

15. Tracer released between 2200 and 0337 PDT on September 16, and September 17, 1979 from Oildale was again initially transported by the nighttime winds towards the center of the San Joaquin Valley. During this release, however, the afternoon northwesterly flow did not lead to transport of the tracer back through the release zone. Instead the early release time led to measurable impacts as far north as Delano and Richgrove. During the afternoon, the upslope flow in those areas presumably led to transport of the tracer into the southern Sierra National Forest, 25-30 miles north of Bakersfield.

16. Tracer released between 0900 and 1400 PDT on September 21, 1979 from Manteca was transported towards the south along Hwy 99. Two previous Manteca experiments conducted during the summer intensive led to transport down the western half of the San Joaquin Valley. During this experiment, however, the tracer was primarily transported slowly along Hwy 99, on the eastern side of the valley. 10-20 ppt SF_6 was detected near Fresno on the day after the release. While most of the tracer was in the northcentral part of the valley, apparently some of the tracer was transported by strong northerly winds on the western side of the valley in that a distinct SF_6 plume (maximum concentration 27 ppt) was detected at Bakersfield during mid-day on the day following the release.